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DR. FOTHERGILL'S FRIENDSHIP WITH BENJAMIN FRANKLIN

BETSY COPPING CORNER

(*Read April 25, 1958*)

LONDON's eminent Quaker physician Dr. John Fothergill, in a letter dated 18 March 1751, written to his friend Dr. William Cuming, a country doctor in Dorset, described a present he was sending him. It is, he said,

> a tract upon Electricity, wrote by a Gentleman with whom I have corresponded, and who I think has said more sensible things on the subject, and let us see more into the nature of this delicate affair than all the other writers put together. . . . This little work . . . was published under my care, and so far as related to the press, my correction.

The "Gentleman" was none other than Benjamin Franklin; the "tract" Benjamin Franklin's *Observations and Experiments on Electricity made at Philadelphia in America*, a modest pamphlet of epoch-making importance, selling in London for 2/6, published in the spring of 1751 by the editor of the *Gentleman's Magazine*, Edward Cave. Judging from the letter quoted above, copies became available in March, although not advertised for sale until April in the *Gentleman's Magazine*.

This letter from Dr. Fothergill to Dr. Cuming, recently discovered by Dr. Whitfield J. Bell, Jr. among the manuscripts belonging to the Richmond (Virginia) Academy of Medicine, would seem to settle definitely the question of how much Fothergill had to do with directing public attention to Franklin's early electrical experiments. Franklin has recorded, in the section of his life-story begun in August, 1788, when he was eighty-two,[1] that out of gratitude for the gift of a glass tube sent in 1746 to Philadelphia from London by Peter Collinson, Quaker merchant, Fellow of the Royal Society and patron of science, he felt it necessary to inform Collinson of its successful use, and thereafter wrote him several letters describing the experiments undertaken and the results obtained. Collinson, thereupon, took occasion to read these letters at sessions of the Royal Society "where," Franklin says, "they were not at first thought worthy of so much notice as to be printed in their *Transactions*." Examination of the Royal Society's Philosophical *Transactions* for the years 1747 to 1752 inclusive reveals only scanty references to Franklin's experiments. No complete letter of Franklin was printed in the *Transactions* until after Cave's 1751 publication of the "little work" Fothergill has described. Three months later Franklin's London rival, William Watson, F.R.S. (later Sir William),[2] read a favorable review of the book at a meeting of the Royal Society on June 6, 1751. This review and two important letters of Franklin, including the account of the famous electrical kite, appeared in Vol. XLVII of the *Transactions* for the years 1751–1752, but this volume was not actually published until 1753.[3]

Collinson also showed Franklin's letters privately to his close friend Dr. Fothergill, largely because of Fothergill's intimate relationship with Philadelphia Quakers which had come about through his selection by London Yearly Meeting as official correspondent[4] to the similar organization in Philadelphia's Society of Friends. Dr. Fothergill's letters, constantly crossing the ocean after this appointment, many of them addressed to the prosperous Quaker merchants Israel and James Pemberton, were much concerned with every aspect of colonial development. He wrote also occasionally to James Logan, statesman and scientist, known as "the most learned man in the colonies"; and later, more frequently to James's son William Logan. The report of James Logan's important experiments on the fertilization of Indian corn—conducted in his own garden on Second Street, Philadelphia—first published in Leyden through the influence of the botanist Joannes Fredericus Gronovius, perhaps at the instigation

[1] *Benjamin Franklin's autobiographical writings*, ed., Carl Van Doren, 750, New York, Viking, 1945.

[2] William Watson's contributions are fully discussed by I. Bernard Cohen, *Franklin and Newton, an enquiry into speculative experimental science and Franklin's work in electricity as an example thereof, Mem. Amer. Philos. Soc.* **43**: 390–413, Philadelphia, 1956.

[3] The Royal Society awarded its Copley gold medal to Franklin, 30 November 1753, and elected him as Fellow, 29 May 1756. Carl Van Doren, *Benjamin Franklin*, 170, New York, Viking, 1945.

[4] Dr. Fothergill to Israel Pemberton, London, April 3, 1743, Mss. Fothergill Letters, Hist. Soc. Penna.

of Peter Collinson, had been translated into English, supplied with a foreword by Dr. Fothergill, and given a London imprint in 1747.[5] This was the very time when the new scientific wonder, electricity, was engaging widespread attention by its potentialities, its dangers, and its possible applications for human benefit. Doubtless Dr. Fothergill, ever eager to further colonial achievements, was sufficiently impressed by Franklin's startling results with the new element to advocate immediate publication of his experiments. We may be justified in surmising that one of two things happened. Either Dr. Fothergill offered his services as editor of Franklin's observations upon electricity, or Peter Collinson, well aware of Fothergill's success with James Logan's book, chose him to perform a somewhat similar task for Franklin's contribution to science.

Franklin's statement of the case, written in 1788, is straightforward. Dr. Fothergill, he tells us, had thought his letters to Collinson of "too much value to be stifled," and since the Royal Society had not seen fit to include them in its *Transactions,* he "advised the printing of them." Accordingly, "Mr. Collinson then gave them to Cave for printing in the *Gentleman's Magazine;* but he chose to print them separately in a pamphlet, and Dr. Fothergill wrote the preface." It is interesting to note that the preface makes no mention of Dr. Fothergill's name but is merely signed, suggestively, *The Editor.*

Dr. I. Bernard Cohen in the first of his excellent Franklin studies, entitled *Benjamin Franklin's Experiments,* in which he amplifies with a critical and historical introduction, a reprinting of the original observations made in colonial Philadelphia, seems inclined to give major credit for their first publication to Peter Collinson. Mr. Cohen has already hinted that we must be cautious about accepting as authentic the memories of an octogenarian when decades have elapsed before he recounts the events of his earlier life.[6] But since Franklin's memory of what steps his friends had taken thirty-seven years earlier to get his experiments printed in 1751 agrees substantially with Dr. Fothergill's report of his part in their recent publication—detailed March 18, 1751,[7] in his letter to Dr. Cuming—how can we do otherwise than accept this evidence, clearly set before us by both author and editor of the "pamphlet," as the authentic story of its origin. The announcement of the availability of the work in March is a month earlier than the time hitherto ascribed to its appearance.

It was not until midsummer of 1757 that Franklin and Fothergill first met. Franklin had come to London on a political mission for the Pennsylvania Assembly. The two men took an instant liking to each other. Their love of useful knowledge which had previously united them, sight unseen, provided a solid basis for continued trust, each admiring the other for his integrity of purpose. John Fothergill, the strict Quaker doctor reputed to have the largest practice in London, had set a straight course for himself hedged about by the necessities of his profession and the restriction of his religious faith as a member of the Society of Friends. His patients admired him for his skill and compassion, but people in general were a little afraid of him because he was different both in manner and appearance from other Londoners they knew. Many found it a laughing matter when the playwright Samuel Foote lampooned him in a topical play as Dr. Melchisedech Broadbrim,[8] but Dr. Fothergill was distressed by the ridicule. Benjamin Franklin, utterly different in temperament and bearing, completely extroverted, genial, informal, talkative, and witty, captivated people at first sight by his natural charm, that gift of the gods. He was without the compulsions of a profession, without religious affiliation, without even the pretense of being better than other men, although before he was twenty-five, after a series of trials and errors, he had drawn up a set of moral precepts to guide his conduct and believed for a time, mistakenly, in

[5] Dr. Fothergill's foreword, called *The Translator's Advertisement,* describes Logan's style as "nervous, concise and Roman," difficult to imitate. He compliments Logan's "capacity for abstrusest Researches." Latin and English are given on opposite pages of this edition. The original Latin title appears on the title page: *Experimenta et Meletemata de Plantarum Generatione, Jacobus Logan, Autore, Judice supremo et Praesidi Concilii Provinciae Pensylvaniensis in America;* C. Davis, over-against Gray's-Inn Gate, Holborn, 1747. Frederick B. Tolles, *James Logan and the culture of provincial America,* 217–218, Boston, Little, Brown, 1957.

[6] "One must be very cautious about statements in the Autobiography." I. Bernard Cohen, ed., *Benjamin Franklin's experiments, a new edition of Franklin's experiments and observations on electricity,* 84, Cambridge, Mass., Harvard Univ. Press, 1941.

[7] Under "Books Published April 1751," the *Gentleman's Magazine* lists *Experiments and observations on electricity,* made at Philadelphia by Mr. B. Franklin, 4 to., 2s. 6d., Cave. Dr. Fothergill's letter, *op. cit.,* advances the date of publication to March, 1751.

[8] Betsy Copping Corner, Dr. Melchisedech Broadbrim and the playwright, *Jour. Hist. Medicine and Allied Sciences* 7(2): 122–135, 1952.

the possibility of his own perfectibility. In 1748, by careful arrangement, he retired from his printing business, aged forty-two. Franklin, as a free man, hoped to use his leisure "to read, study and make experiments," he told Cadwallader Colden.[9] This dream of a scientific career and the calm enjoyment of philosophical pursuits was doomed, alas. Calls of public service, beginning almost at once, demanded constant exercise of his unusual powers throughout the rest of a long life during a century of social upheaval. In the whirl of international affairs, where his agile mind and social flexibility gave him power to improvise and implement grand projects which men cast in conventional molds would never have conceived, he found another kind of happiness and gained world-wide reputation.

In 1757 Franklin's object in England was establishment of a working agreement between Great Britain and the province of Pennsylvania which should put an end to constant contention between the provincial Assembly and Thomas Penn, the absentee Proprietor. He himself wished that Pennsylvania might become a royal colony, directly under protection of the King. Dr. Fothergill arranged a meeting for him with Thomas Penn. John Hanbury of Tower Street, the great "Virginia tobacco merchant" (who had overseas business dealings with George Washington), took him in his carriage to interview Lord Granville, President of the Privy Council. Wherever he went Franklin talked eloquently about Pennsylvania's problems, beset as she was by French intrigue with her Indian neighbors, baffled by an Assembly filled with Quaker members who opposed military defense of the frontier suffering from Indian massacres, hampered financially by proprietary insistence on exemption of vast proprietary lands from taxation. Worn out by his efforts he was housed by a severe cold in early September, resumed work too soon, and fell seriously ill. During an eight weeks' siege Dr. Fothergill was his physician, "attending me very carefully and affectionately," he wrote home to Deborah, his anxious wife.[10] This close association between the two men cemented a friendship which was to endure until broken by Dr. Fothergill's death in 1780.

Franklin's work on Pennsylvania's problems kept him in London until August, 1762. Dr. Fothergill had supported his efforts determinedly from the very first. When Philadelphia Quakers had asked their London correspondent for news of Franklin,

> You must give him time [Fothergill had replied] and without repining. He is equally able and solicitous to serve the Province, but his obstructions are almost unsurmountable. Great pains had been taken, and very successfully, to render him odious and his integrity suspected, to those very persons to whom he must first apply. These suspicions can only be worn off by time and prudence.[11]

The prediction was shrewd. In less than a year Fothergill could assure them:

> B. Franklin has acquired the confidence and esteem of many persons in high station, and by his clear and solid reasoning has in some degree recovered a very favourable ear.[12]

Throughout the entire period of Franklin's residence in England not one word of criticism against him was ever uttered by his friend John Fothergill in letters to Philadelphians.

As Franklin sailed for America in late August, 1762, Dr. Fothergill was enjoying the excitement of acquiring a country place in Upton,[13] a few miles outside London, where he planned to indulge his botanical interests by establishing a garden to be filled with "exoticks" obtained from enterprising sea captains and from John Bartram and Humphrey Marshall of Pennsylvania who were already sending him North American plants, shrubs, and young trees.[14] Periodic escape from London to the delights of the country had become essential to the maintenance of his physical health and mental poise. His practice had grown to an oppressive size. He had no time for social correspondence or the cultivation of friendships, his favorite means of relaxation from heavy cares.

> Not a day, not an hour is exempt from calls not easily to be denied [he wrote to Israel Pemberton]. This is my situation at present, and how to extricate myself I cannot yet see; neither love of money, nor any pleasure I have in my business more than a duty

[9] Cadwallader Colden (1688–1776), an important figure in early American science, became Lieutenant-Governor of New York in 1761. *Dict. Natl. Biog.*

[10] *The writings of Benjamin Franklin*, 10 vols., ed., A. H. Smyth, **3**: 419, New York, Macmillan, 1905–1907.

[11] Dr. Fothergill to Israel Pemberton, London, Dec. 6, 1758, Mss. Fothergill Letters, Hist. Soc. Penna.

[12] *Idem.*, London, Sept. 4, 1759.

[13] *The works of John Fothergill*, M.D., ed., John Coakley Lettsom, M.D., **3**: 37–50, London, 1784.

[14] William Darlington, *Memorials of John Bartram and Humphrey Marshall with notices of their botanical contemporaries* (*passim*), Philadelphia, 1849.

to the publick, urges me to undergo as laborious an employ as I can ill sustain.[15]

Franklin on the other side of the sea, remembering his overburdened friend, decided to chide him, hoping perhaps that Fothergill would take his remonstrance like a dose of medicine.

Dear Doctor [he wrote March 14, 1764],

I received your favour of 10th December. It was a great deal for one to write whose time is so little his own, By the way, when do you intend to live?—i.e. to enjoy life? When will you retire to your villa, give yourself repose, delight in viewing the operations of nature in the vegetative creation, assist her in her works, get your ingenious friends about you, make them happy with your conversation and enjoy theirs, or if alone; amuse yourself with your books and elegant collections?

To be hurried about from one sick chamber to another is not living. Do you please yourself with the fancy that you are doing good? You are mistaken. Half the lives you save are not worth saving as being useless, and almost all the other half ought not to be saved as being mischievous. Does your conscience never hint to you the impiety of being in constant warfare against the plans of Providence.[16]

By the end of 1764 Franklin was back again in London and there he would remain—although he did not know it—engaged in fact-finding and diplomacy until March, 1775. This troubled decade brought the diplomat and the doctor close together as they faced the gathering storm with grave concern. Dr. Fothergill was horrified by the Stamp Act. Among the flood of pamphlets both pro and con coming from the press, his contribution was outstanding. Entitled *Considerations Relative to the American Colonies*, it revealed surprising knowledge of commercial, geographical and sociological conditions in a country he had never seen. He stressed the extraordinary opportunity these colonial possessions afforded Great Britain, restricted by her island boundaries, for expansion and growth into a world power which should endure. Repeal of the Stamp Act was essential. Repeal, and only repeal, would

convince the Americans so fully of British equity and moderation that they would no longer suspect designs against their freedom, their priviledges and interests. The Americans, if permitted to trade as they have done, to raise every kind of raw materials of which we have need either for use or commerce, if rendered by such means to be dependent upon us, will be so continually,

he claimed. He feared a house divided against itself, a kingdom split. "Riots, tumults, every species of anarchy that a people mad with oppression" can be driven to had been reported. Inevitably there would be stagnation of commerce. Already the colonists were retaliating with resolutions for non-importation of British goods. A multitude of British manufacturers were facing ruin. Where would it end? What could be expected from people "bred up almost in independency and full of republican principles" when without consultation, or application to their houses of representatives, taxation reaching down to their everyday expenditures was suddenly imposed by parliamentary act?[17]

At the very end of his pamphlet, wrath subsiding, argument ended, idealism triumphs with a pronouncement extraordinary for his day:

If we promote scholarships for Americans in our Universities; give posts and benefits in America to such Americans who have studied here, preferably to others; if the Government permits such youth to come over in the King's ships *gratis*, we shall unite . . . more firmly. The Americans, by mixing with our own youth at the University, will diffuse a spirit of enquiry after America and its affairs; they will cement friendships on both sides [the sea] which will be of more lasting benefit to both countries than all the armies Britain can send thither.[18]

In Philadelphia a new storm of protest burst forth when the rumor began to circulate that Franklin had not only supported the Stamp Act but had framed it. This idea had arisen, no doubt, because parliamentary leaders had thought a law to be operative in America should be administered by Americans. Franklin, believing that his countrymen would temporarily submit to the regulation until they had had time to organize a dignified means of opposition and present a petition for repeal to the King, had acquiesced to this in his diplomatic capacity by appointing John Hughes as collector for Pennsylvania and suggesting other suitable names elsewhere. The Pembertons were among those writing anxiously from Philadelphia. Dr. Fothergill's defense of Franklin was a prompt, vigorous, emphatic denial of the slander. For publication in Philadelphia newspapers he sent an attestation praising Frank-

[15] Dr. Fothergill to Israel Pemberton, London, Dec. 6, 1758, *op. cit.*, Hist. Soc. Penna.

[16] Smyth, ed., *op. cit.* **4**: 221–226.

[17] Lettsom, ed., *op. cit.* **2**: 381–416.

[18] *Idem*, 416.

lin as "an able, useful advocate for America in general and the province of Pennsylvania in particular." From first to last he had done all in his power to oppose the Stamp Act, always asserting "the rights and priviledges of America with the utmost firmness, resolution and capacity." During three hours of a grilling examination in the House of Commons he had given an extraordinary exhibition, fully exposing the "mischievous tendencies" of the Stamp Act.[19]

But the discontents continued. The English colonists in America, about to throw off the British yoke, had acquired a new allegiance to a new country, and Franklin was their interpreter. His pen was never idle. As a printer he had long enjoyed intimate friendship with William Strahan, a Scotsman transplanted to London whose printing house was publishing Johnson's dictionary, the novels of Smollet and Sterne and works of Robertson, Hume, and Gibbon as they appeared. Strahan also published the *Monthly Review* and the *London Chronicle*, a tri-weekly evening paper. Through Strahan, Franklin was introduced to the inner circle of printers. Liked by these men, he seized the opportunity gained by their acquaintance to use the press as a vehicle for American propaganda, disguising the constant flow of his work, as best he could, by the use of a variety of pseudonyms. A series of argumentative imaginary dialogues, political fables, satires, and brilliant essays, when dispatched to the *London Chronicle* already mentioned, to the *Public Ledger*, or to the *Gazetteer and New Daily Advertiser*, found ready publication. Many of these pieces, reprinted or extracted for publication in colonial news-sheets, were especially relished in Philadelphia.[20]

It was not hard for Franklin to throw off his cares at times to take advantage of enjoyments which life in London offered. Dr. Fothergill's escape from sickroom and meeting house was far less frequent. We know that the two friends must have met occasionally at the Club of Honest Whigs to which both belonged, and there is a report from Franklin's pen of an occasion when the two deliberated on a pleasant colonial problem presented by the arrival of a shipment of silk from Philadelphia. Both of them had become interested in an experiment of silk-growing in Pennsylvania where mulberry trees and silkworms had been introduced with some success and a Silk Company had been organized. When the shipload of silk arrived at London docks in February, 1772, considerable delay arose in getting it through Customs. Finding inspectors capable of estimating the value of the cargo was the difficulty. But at last the trunks were dispatched to Franklin's house in Craven Street and Dr. Fothergill soon arrived to help unpack them. Two gray heads bowed over the contents. What a mess they found! All the parcels had been opened and not made up again. Cards carefully labeled with information and directions were scattered. It was impossible to decide which parcels had been intended for Queen Charlotte and which for the ladies of the Penn household. In despair they sent, eventually, for a Mr. Patterson, evidently an authority on silk, to come and pick out six pounds of the best for the Queen and four pounds suitable for each of the other favored ladies. The Craven Street diversion had a sequel. Franklin was invited to Dr. Fothergill's house to view the doctor's collection of treasured Chinese drawings and assist him in choosing a series of prints "representing the process of raising silk from its beginning to end," which they would then send to the Pennsylvania Silk Company as a token of appreciation.[21]

By 1774 Franklin and Dr. Fothergill agreed that the colonial prospect had grown dark and threatening. The Boston Tea Party had brought vengeance upon Massachusetts. The Boston Port Bill had imprisoned her commercially. A series of "intolerable acts" which Fothergill said would "disgrace the annals of the present time" had welded colonial opposition into a resistant whole.

Dr. Fothergill described the situation as he saw it in an impassioned letter sent to a friend in India:[22]

> They begin to find the infant too much a man to be whip'd like a schoolboy, and see with amazement what they ought long since to have known, that two or three millions of people abounding with all the necessaries of life cannot be kept in subjection by 8 millions of people at the distance of more than three thousand miles. . . . We have 5 or 6 thousand men in a province where they can muster 50,000 men, well-train'd, arm'd and disciplined, and led by officers

[19] Van Doren, *op. cit.*, 336–352; Dr. Fothergill to Israel Pemberton, London, Feb. 27, 1766; Aug. 4, 1766, Hist. Soc. Penna.

[20] *Benjamin Franklin's letters to the press*, ed., Verner W. Crane, **21–30**, Chapel Hill, Univ. N. Carolina Press, 1950.

[21] Smyth, ed., *op. cit.* **5**: 338–389.

[22] From Charles Roberts Collection, Haverford College, Pa.; printed in *Bull. Friends Hist. Soc. of Philadelphia*, 2–8, April, 1913.

who fought at Louisbourg, Martinico and Havannah. Yet this is one province only. I should not doubt but a Confederacy would bring into the field near 100,000 men. What force have we to oppose to such an army of Englishmen rendered desperate by the prospect of oppression? . . . Shall we dismember such a part of the Brittish [*sic*] Empire for moonshine?

What could be done to prevent War? Dr. Fothergill's solution was a series of talks between Americans and Britons to be arranged informally on a parliamentary level.[23] He proposed that "sensible, sedate persons," elected with discretion in America by their respective colonial governments, should come to London immediately for interviews with members of both houses of Parliament, which their colonial agents and certain North America merchants would encourage and arrange. These well-qualified American visitors, using the utmost moderation yet firmness, producing full information of their situation, could urge with the force of personal communication "the mutual and reciprocal advantage of a great Empire" which only Peace could save. "If something of this sort is not attempted," he warned, "both you and we are on the brink of a fatal precipice. Petitions, memorials, addresses, with whatever cogency of reason they are composed, will be totally inadequate."

The estrangement had progressed far beyond the stage of possible settlement by deliberations. Catastrophe seemed inevitable. Yet beginning in December, 1774, three men had a series of meetings in Dr. Fothergill's Harpur Street study in a last minute attempt to start negotiations to prevent the fatality of war.[24] Benjamin Franklin was there representing the American Colonies; David Barclay came as chief of the English "North America Merchants"; Dr. Fothergill, as member of the Society of Friends, may well be given the title of Peacemaker.[25] The task assigned to Franklin at the first session was preparation of a document presenting possible terms for peaceful settlement of the disagreements between Great Britain and her colonies. At their next meeting Franklin produced seventeen propositions which he called *Hints for Conversation*, not demands, and later changed to a still more mollifying title: *A Plan Which 'Tis Believed Would Produce a Permanent Union Between Great Britain and Her Colonies.*[26]

Two patients of Dr. Fothergill are significant in this story: Lord Dartmouth, Colonial Secretary for North America, whom Dr. Fothergill was visiting daily in professional capacity at this time, and Lord Hyde, David Barclay's trusted friend, and elder statesman, with diplomatic experience. Neither of these men was ever present at the Harpur Street sessions. The Hints, however—but without their author's signature which might have been harmfully prejudicial in political circles—were certainly placed in their hands. Perhaps these noble lords may have presented these propositions to other members of the British Cabinet; perhaps even to Lord North, the Prime Minister with whom Lord Dartmouth was on brotherly terms. There is no evidence; therefore no proof. All we know is that both Lord Dartmouth and Lord Hyde saw the terms originating in Harpur Street. After study Lord Dartmouth delivered the verdict to Dr. Fothergill; the answer was final; though some of the points seemed reasonable, others were utterly impracticable; on the whole the terms were "too high" for consideration.

Just as disappointment faced the triumvirate, Franklin received news that Deborah, his wife, had died unexpectedly in Philadelphia. He had already planned a departure from England which now he must hasten. He sailed for America in mid-March. By the time he reached Philadelphia in early May, the battles of Concord and Lexington were things of the past; the Colonies were in the midst of their desperate struggle in warfare for freedom.

During the War for Independence communication between Franklin and Fothergill was practically at a standstill. Only a few letters got through to the Pembertons and William Logan of the Society of Friends. What seems to be the last letter Fothergill ever wrote, one penned to his friend the diplomat then in France, is possessed by the American Philosophical Society. Dated October 25, 1780, only two months before Dr. Fothergill's death, it evidently answers a query which Franklin had made in concern about his health, already impaired by his bladder stone. Advice for the alleviation of Franklin's pain is followed at length by a plan conceived with the old familiar Fothergillian brand of idealism. The

[23] Dr. Fothergill to James Pemberton, London, July 23, 1774, Hist. Soc. Penna.

[24] Van Doren, *op. cit.*, 497–503.

[25] Betsy Copping Corner and D. W. Singer, Dr. John Fothergill, peacemaker, *Proc. Amer. Philos. Soc.* **98**(1): 11–22, 1954.

[26] R. Hingston Fox, *Dr. John Fothergill and his friends*, Appendix I, 393–408, London, Macmillan, 1919.

doctor proposed nothing less than a concerted effort for the abolition of wars by the institution of a College of Justice where the claims of disputing nations may be "weighed" and adjusted without recourse to the barbaric slaughter war entails. Only upon the nation refusing to submit to adjudication would war be justified. To bring this to pass:

> No man in the world has it so much in his power as my honoured Friend to infuse this thought into the breasts of Princes or of those who rule them and their affairs.

Looking backward to their last meetings at the Harpur Street conferences, he asserted, with a burst of pride:

> Much horrible mischief would indeed have been prevented had our Superiors thought fit to pay any regard to our humble endeavours. But their ears were shut, their hearts hardened—Kings became delirious, and the poor Greeks suffered for it.[27]

Franklin, in France representing the American Colonies at one of Europe's foremost courts, was in Passy when the news of Dr. Fothergill's death reached him in a letter[28] from Dr. Fothergill's young American cousin Benjamin Waterhouse,[29] then concluding his medical studies in Leyden. Franklin was saddened by the loss of his old friend, but death could never destroy what they had shared, and the thought of Dr. Fothergill's extraordinary devotion to the American Colonies would always gild remembrance of things past. In reply to Dr. Waterhouse he wrote a tribute which came from a full heart:

> I condole with you most sincerely on this occasion. I think a worthier man never lived: For besides his constant readiness to serve his friends, he was always projecting something for the Good of his Country and of Mankind; and putting others who had it in their power executing what was out of his own Reach, but whatever was in it he took care to do himself; and his incredible Industry and unwearied Activity enabled him to do much more than can now be ever known, his Modesty being equal to his other Virtues.[30]

[27] Dr. Fothergill to Benjamin Franklin, London, Oct. 25, 1780, Franklin Papers, Amer. Philos. Soc. The allusion is to Horace, Epistles I, ii, 14: *Quidquid delirant reges, plectuntur Achivi.*

[28] Benjamin Waterhouse to Benjamin Franklin, Leyden, Jan. 10, 1781, Franklin Papers, Amer. Philos. Soc.

[29] Benjamin Waterhouse (1754–1846) later became Harvard's first Professor of Medicine and introduced the practice of vaccination into the United States. John B. Blake, *Benjamin Waterhouse, the introduction of vaccination, a reappraisal,* Philadelphia, Univ. of Penna. Press, 1957. Dr. Fothergill's Aunt Rebecca, his father's youngest sister, married John Proud in Yorkshire. They emigrated to America where their daughter married Timothy Waterhouse of Newport, Rhode Island; their son Benjamin Waterhouse and Dr. John Fothergill were therefore first cousins, once removed, "Fothergill Genealogy," *Ackworth School Cupola* **6**, *supplement,* 1935.

[30] Benjamin Franklin to Dr. Benjamin Waterhouse, Passy, Jan. 18, 1781, Letter-book, Library of Congress.

THE MEGALONYX, THE MEGATHERIUM, AND THOMAS JEFFERSON'S LAPSE OF MEMORY

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"My farm, my family, my books, and my building give me much more pleasure than any public office would, and especially one which would keep me constantly from them." [1] Thus, like Washington and many others of the day, Thomas Jefferson voiced his longing for the domestic felicities so often denied him by the compulsions of public duty. When he resigned as Secretary of State in 1793, secure in the galling knowledge that his great rival had a dominant influence on the policies of the administration, his beloved mountain-top in Albemarle was a healing consolation. There in the ensuing years he supervised the rounds of planting and harvest, experimented with his improved mold-board plow, introduced a system of crop rotation, corresponded with the leading exponents of agricultural reform in England, constructed a threshing machine on the Virginia model and made another on the Scottish plan, mounting it on wheels so that it could be moved from barn to barn, established a nail factory that could be operated by a dozen slave boys, carried forward major repairs and new construction on his ever changing Monticello, received such distinguished visitors as Volney and Rochefoucauld-Liancourt, and, farmer-like, put off answering letters to a rainy day. It was a happy life, thoroughly congenial to him, and the summit of his felicity was achieved in the company of his two daughters, the elder with a growing family. There was comfort, too, as well as expanding horizons, in the thousands of well-selected volumes that brought within his reach the best of Athens and Rome along with the latest from Paris and London, ancient classics and modern science achieving at his hands a well-integrated harmony. Early in life, as Chastellux so aptly remarked, he had placed his mind as well as his home upon a lofty place from which to contemplate the universe. He had no desire now to leave that elevated spot. "No circumstance," he wrote to his successor in office, "will ever more tempt me to engage in anything public." [2] To his great confidant, James Madison, he declared that the question was "forever closed" and that his "retirement from office had been meant from all office, high or low, without exception." [3]

He had said the same thing a dozen years earlier, when his sensibilities had been even more deeply wounded. That both resolutions gave way to other exigent pressures need not be taken as proof of insincerity. Jefferson's passion for the delights of husbandry was indubitably genuine and profound. But so, too, was his concern for public policy, and the fact that he was led a second time to revoke his irrevocable decision is only a measure of the strength of the colliding forces. The man who had, in the felicitous words of President Stiles of Yale, "poured the soul of the continent into the monumental Act of independence" [4] was not likely to sit silently among his books as he watched events come to a head in the year 1796. It would have been better, perhaps, if one of his farmer's rainy-day letters had not been penned. To Philip Mazzei he phrased an angry indictment of the drift of affairs in Washington's second administration:

> In place of that noble love of liberty and republican government which carried us triumphantly thro' the war, an Anglican monarchical and aristocratical party has sprung up, whose avowed object is to draw over us the substance as they have already done the forms of the British government. The main body of our citizens however remain true to their republican principles. The whole landed interest is republican, and so is a great mass of talents. Against us are the

[1] Thomas Jefferson to Count Volney, January 8, 1797 (in Jefferson Papers, Library of Congress, as are all other Jefferson letters and manuscripts cited below unless otherwise indicated). The best compendium of information about all aspects of Jefferson as a planter is Edwin Morris Betts, ed., Thomas Jefferson's farm book with commentary and relevant extracts from other writings, *Mem. Amer. Philos. Soc.* **35**, 1953.

[2] Jefferson to Edmund Randolph, September 7, 1794.

[3] Jefferson to James Madison, April 27, 1795.

[4] Ezra Stiles, *The United States elevated to power and glory*, New Haven, 1783.

Executive, the Judiciary, two out of three branches of the legislature, all of the officers of the government, all who want to be officers, all timid men who prefer the calm of despotism to the boisterous sea of liberty, British merchants and Americans trading on British capitals, speculators and holders in the banks and public funds.[5]

Because of Mazzei's indiscretion, the words soon echoed through Europe and America, bringing acute embarrassment to Jefferson and producing a breach between him and Washington that was never closed.

He hoped the newspapers would let him plant his cow-peas in hills or drills as he chose, but the most conspicuous husbandman on the continent had no chance to remain in retirement. Leaders of what was known as Mr. Madison's party looked hopefully to Jefferson as the only one who could stem the tide, and, without benefit of political devices whose perfection lay in the future, established his candidacy and made withdrawal from it all but impossible. Madison, the astute leader, gave him no chance to refuse and even the enemy, focusing their gaze on Monticello as well, helped create the web. The old, discredited charges were brought forth for a voting populace that had been in its nonage when Tarleton raided Monticello in 1781, and new ones were invented.[6] The Virginia planter, amiably enjoying his fields, his books, and his family, was pictured as the tool of a foreign power, as a devotee of French philosophy, as a foe to religion and morality through his study of the newer sciences of the earth, as an errant leader of youth and a subverter of authority. Even Hamilton helped by declaring: "every thing must give way to the great object of excluding Jefferson" as Washington's possible successor.[7]

Such tensions were bound to destroy Jefferson's stout resolution against "all intermeddling with publick affairs and public bodies." Nor were they conducive to the kind of scientific inquiry that his political enemies sometimes denounced and frequently ridiculed. Yet in the period of tense waiting before Washington's Farewell Address gave "a signal, like dropping a hat, for the party racers to start,"[8] Jefferson received a letter from John Stuart in Greenbrier County that touched upon one of his favorite studies.

> Being informed you have retired from Public Business and returned to your former residence in Albemarle, [Stuart wrote,] and observing by your Notes your very curious desire for Examining into the antiquity of our Country, I thought the Bones of a Tremendious Animal of the Clawed kind lately found . . . by some Saltpetre manufacturers about five miles from my House might afford you some amusement, have therefore procured you such as were saved.

If Stuart had let the matter rest there, he would have served his friend better, but instead he plunged into conjectures that operated with the powerful strength of suggestion.

> I do not remember, [he added,] to have seen any account in the History of our Country, or any other, of such an animal, which was probably of the Lion kind. I am induced to think so from a perfect figure of that animal carved upon a rock near the confluence of the Great Kenawha, which appears to have been done many centuries ago.[9]

This planted a germ that incubated rapidly.

To Stuart's kinsman and his former student, Archibald Stuart, who had also reported the discovery, Jefferson wrote that the "leg bone and two joints of the toe of the animal" belonged to "a species not yet known most certainly," but that the animal must have been as preeminent over the lion, as the big buffalo was over the elephant. The

[5] Jefferson to Philip Mazzei, April 24, 1796. On the repercussions caused by the publication of this letter in Italy, in France, and then throughout the United States, where Federalist newspapers published it as having been written by Jefferson while Secretary of State and as a warning against this "prince of Jacobins, Democrats, Frenchified Tories, and enemies to the present happy constitution and government of the United States" (*The Federalist; New Jersey Gazette*, August 27, 1798), see Howard R. Marraro, The four versions of Jefferson's letter to Mazzei, *William & Mary Quart.*, second ser. **22**: 18–20, Jan. 1942; Noble E. Cunningham, Jr., *The Jeffersonian Republicans*, 118–119, Chapel Hill, 1957.

[6] One of the newly-invented rumors was that Jefferson was being sued for a debt owed British merchants in an amount far exceeding the value of his estate: this was a perversion of facts concerning the suit of Jones v. Wayles' Executors for £12,000 sterling for a cargo of slaves shipped in 1772 to John Wayles, Jefferson's father-in-law, and his partner, Richard Randolph. Jefferson held that he and his co-executors were not obligated either in law or equity, an opinion shared not only by John Marshall, who was counsel for the defendant in the case, but also by the jury (Stephen T. Mason to Daniel C. Brent, October 25, 1796; the relevant documents in the case are to be found in Vol. **15**, *The Papers of Thomas Jefferson*).

[7] Hamilton to an unidentified recipient, 1796 (quoted by Cunningham, *op. cit.*, 93, citing Lodge, ed., *Hamilton works* **8**: 419).

[8] Cunningham, *op. cit.*, 93, citing Fisher Ames to Oliver Wolcott, September 26, 1796, Gibbs, ed., *Administrations of Washington and Adams* **1**: 384.

[9] John Stuart to Jefferson, April 11, 1796.

bones are too extraordinary in themselves, and too victorious an evidence against the pretended degeneracy of animal nature in our continent, not to excite the strongest desire to push the enquiry after all other remains of the same animal which any industry can recover for us.[10]

Here, only a few days after he had read John Stuart's conjecture that the bones were probably those of a lion, Jefferson had eagerly embraced them as a club to use against Buffon.

He was conditioned to accept the idea that he was dealing with the skeletal remains of a giant member of the felidae. The theory of Buffon and other European scientists that the American climate had a degenerative effect upon life was one that John Adams could toss aside as unworthy of the time and effort that Jefferson had expended in refutation in his *Notes on Virginia*. But Jefferson had kept on piling proof on proof, including the skin and bones of an American moose that, at enormous cost, he had presented to Buffon himself. Thus the discovery of fossilized bones of a clawed animal three or four times the size of a lion afforded a truly "victorious evidence" in rebuttal, and Jefferson lost no time in reporting the event to David Rittenhouse, president of the American Philosophical Society and, in Jefferson's view, a scientific genius of the first order.

Some makers of saltpetre, [he wrote to Rittenhouse,] in digging up the floor of one of those caves beyond the blue ridge, with which you know the limestone country abounds, found some of the bones of an animal of the family of the lion, tyger, panther &c. but as preeminent over the lion in size as the Mammoth is over the elephant. I have now in my possession the principal bones of a leg, the claws, and other phalanges, and hope soon to receive some others, as I have taken measures for obtaining what are not already lost or may still be found. One of the claw bones in my possession, without it's horny fang, measures 7. inches long, and a larger one was found and has been lost. This phalange in the lion is under 2. inches in length. It's bulk entitles it to give to our animal the name of the Great-claw, or Megalonyx. The leg bone does not indicate so vast an excess of size, over that of the lion, perhaps not more than a double or treble mass. But of this we shall be better able to judge when a fuller collection of the bones shall be made. The whole of them shall be deposited with the society.[11]

[10] Jefferson to Archibald Stuart, May 26, 1796.

[11] Jefferson to David Rittenhouse, July 3, 1796 (retained file copy in Library of Congress, received copy in Library of the American Philosophical Society).

Urged on by Jefferson's eager prompting, John Stuart visited the cave himself and found a few more bones, but no teeth as he had hoped. He reported from memory a story he had heard in 1769 about a party of hunters who had camped on the Cheat River a few years earlier and had heard an "astonishing roaring . . . as loud as thunder" that cowed them and their dogs. This and the discovery of the bones had led him to think that "such a Creature yet exists." [12] Here was another of Stuart's conjectures, potent with suggestion, and it, too, flourished to speedy maturity in the memoir that Jefferson was preparing for the Society. Archibald Stuart reported the same story, at greater length and with more graphic details, stating that the hunters had described the beast's roars about the campfire as having "exceeded the loudest peals of Thunder they had ever heard." [13] A medical kinsman visiting Jefferson about this time stimulated imagination still further by recounting a tale of a French scientific traveler who reported upon methods of hunting lions employed by the Moors, in which it was shown that horses and dogs were terrorized to the point of paralysis and could be defended only by means of fires.[14] The Kentucky hunters and their dogs' fright fell in conveniently with the long-dying theory of the continuity of species, to which Jefferson clung tenaciously.

Rittenhouse never saw Jefferson's letter, for he had died a week before it was written. But his nephew, Dr. Benjamin Smith Barton, replied to it, announced that the fourth volume of the Society's *Transactions* was already in press with 150 pages run off, and said that Jefferson's memoir on the bones would be very acceptable and would arrive in time if received within five or six weeks.[15] But harvest, the new threshing machine, the growing intensity of the political campaign, and the repairs to Monticello interfered with scientific research. More important, Jefferson was daily expecting additional bones of what his correspondents in the west were already calling "the American lion."

There does exist somewhere [he wrote Barton,] a thigh-bone which has been seen by many and is believed to be still in the neighborhood where found.

[12] John Stuart to Jefferson, July 13, 1796.

[13] Archibald Stuart to Jefferson, August 19, 1796.

[14] Philip Turpin to Jefferson, July 18, 1796; Turpin suggested to Jefferson the advisability of making "a few castings of the claws in lead or pewter" before parting with them.

[15] Benjamin S. Barton to Jefferson, August 1, 1796.

This with the bones I have would enable me to give the actual stature of the animal, instead of calculating it on the principle of ex pede Herculem. It will not be long before the diligence which is using for the collection of these bones will produce all which are to be recovered: but I do not flatter myself it will be done by the time at which you suppose the new volume of transactions will be ready. But as I know that that may be delayed, and am anxious this discovery should appear in it, I shall use all the diligence I can to forward it. It has been indeed the most tremendous of animals.[16]

Barton was an accommodating editor. After a wait of several weeks he had said that the memoir would be in time if it arrived in another month, adding perhaps unnecessarily: "We are slow in our motions." Now he wrote, late in October, to say that the fourth volume would not be published for another two months.[17] This inspired Jefferson to spur John Stuart on in the hunt for the missing thigh bone, and he not only promised to delay the memoir until the search proved successful or appeared hopeless, but also held out a delicate hint of nomination for membership in the Society as a further inducement. "I think it happy," he told Stuart, "that this incident will make known to them a person so worthy as yourself to be taken in to their body, and without whose attention to these extraordinary remains the world might have been deprived of the knolege of them."[18]

Even this failed to produce the coveted thigh bone. November passed and the election threatened to interfere still more with Jefferson's agricultural and scientific pursuits. Early in December Madison wrote that it was still not possible "to calculate with any degree of certainty whether you are to be left by the Electors to enjoy the repose to which you are so much attached, or are to be summoned to the arduous trust which depends on their allotment."[19] The choice of words revealed Madison's doubt as to which trust was involved and a few days later, alarmed lest Jefferson refuse to accept the vice presidency, he wrote more urgently: "Exitus in dubio is still the Motto to the election. You *must* reconcile yourself to the secondary as well as the primary station, if that should be your lot."[20] Jefferson thought affairs "never wore so gloomy an aspect since the year 83." but his reply must have cheered Madison:

> The first wish of my heart was that you should have been proposed for the administration of the government. On your declining it I wish any body rather than myself: and there is nothing I so anxiously hope as that my name may come out either second or third. These would be indifferent to me, as the last would leave me at home the whole year, and the other two-thirds of it.[21]

He had no passion to govern men, he told Edward Rutledge, and he saw no reason to covet the helm of state in such a tempestuous sea.[22] But on the first day of the new year, when the outcome was settled, he told Madison that

> no arguments were wanting to reconcile me to a relinquishment of the first office or acquiescence under the second. As to the first, it was impossible that a more solid unwillingness settled on full calculation, could have existed in any man's mind, short of the degree of absolute refusal. The only view on which I would have gone into it for a while was to put our vessel on her republican tack before she should be thrown too much to leeward of her true principles. As to the second, it is the only office in the world about which I am unable to decide in my own mind whether I had rather have it or not have it.

What Jefferson had in mind about the drift of the vessel from her republican tack was clarified in his remark that it would be for the public good to come to some understanding with John Adams about future elections because he was "perhaps the only sure barrier against Hamilton's getting in."[23] Even as a political figure Jefferson was not yet sure of his own strength.

All doubt now being removed about his acceptance of the vice presidency, Jefferson could turn once again to the memoir on the megalonyx. Indeed, the very letter that brought such assurance to Madison proved that "the American lion" was occupying his thoughts at the time. "I do not recollect in all the animal kingdom," he added in commenting upon some choice pamphlets Madison had sent,

[16] Jefferson to Barton, October 10, 1796.

[17] Barton to Jefferson, September 5 and October 25, 1796.

[18] Jefferson to John Stuart, November 10, 1796. Stuart was elected a member of the American Philosophical Society in 1797, but "by some accident unexplained" the diploma was not sent to him until 1801 (Jefferson to Stuart, February 14, 1801; Stuart to Jefferson, March 9, 1801). Jefferson invariably addressed him as "John Stewart," a fact which no doubt explains why this incorrect spelling is recorded on the rolls of the Society (see American Philosophical Society *Year Book* for 1953: 483, 1954).

[19] Madison to Jefferson, December 5, 1796.

[20] Madison to Jefferson, December 10 and 19, 1796.

[21] Jefferson to Madison, December 17, 1796.

[22] Jefferson to Rutledge, December 27, 1796.

[23] Jefferson to Madison, January 1, 1797.

a single species but man which is eternally and systematically engaged in the destruction of it's own species. What is called civilization seems to have no other effect on him than to teach him to pursue the principle of bellum omnium in omnia on a larger scale. . . . When we add to this that as to the other species of animals, the lions and tygers are mere lambs compared with man as a destroyer, we must conclude that it is in man alone that Nature has been able to find a sufficient barrier against the too great multiplication of other animals and of man himself, an equilibrating power against the fecundity of generation. My situation points my views chiefly to his eternal wars in the physical world: yours perhaps exhibit him as equally warring in the moral one. We both, I believe, join in wishing to see him softened.

The officers of the American Philosophical Society were waiting for word from Jefferson not merely as to the megalonyx but also as to his reentry into public life.

> The Philosophical Society propose to place you in the chair vacated by the death of Mr. Rittenhouse, [Benjamin Rush informed him]. This will be done in consequence of your declaration in your letter to Mr. Madison that you will not refuse the office of Vice President of the U States if elected to it. We shall expect you to preside in our Winter meetings.[24]

The formal notice of election came only a few days later:

> The Society, Sir, cannot soon forget the loss they sustained by the Death of the late worthy and ingenious D. Rittenhouse, but, after expressing their grief on this melancholy occasion, they look forward with this consoling Reflection, that, in the same chair, from which two American Philosophers have successively instructed *them*, and *the World*, a Third is now seated; by whose Genius and Knowledge our National Name will preserve a distinguished Place in the Annals of Science.[25]

Jefferson had already decided to go to Philadelphia to take the oath of office as vice president, though this would be "merely out of respect to the public, and to the new President," and now his journey out of retirement—the first time he had left his plantations in almost four years—would lead him not to one but to two high offices. There is no doubt which he valued most: "the suffrage of a body which comprehends whatever the American world has of distinction in philosophy and science in general," he wrote to the secretaries of the Society, "is the most flattering incident of my life, and that to which I am the most sensible."[26] It was now imperative that the memoir on the megalonyx should be finished before he abandoned his mountain top. These determining elections to office coincided with news from John Stuart that the missing thigh bone was nowhere to be found.[27]

Now more reconciled to public office because it promised to give him "philosophical evenings in the winter, and rural days in summer," Jefferson completed his memoir in the firm conviction that the great claw resting before him in his library once belonged to an American lion of a species perhaps even then roaming through the western wilderness. He wrote to Benjamin Rush late in January and revealed no doubt as to the classification of the animal: the bones were those of a beast of the lion kind, but of most exaggerated size. What are we to think of a creature whose claws were 8 Inches long, when those of the lion are not 1½ I. whose thigh bone was 6¼ I. diameter when that of the lion is not 1¼ I.? . . . I have been disappointed in getting the femur as yet, but shall bring on the bones I have, if I can, for the society, and have the pleasure of seeing you for a few days the first week of March. I wish the usual delays of the publications of the society may admit the addition to our new volume of this interesting article which it would be best to have first announced under the sanction of their authority.[28]

The memoir on the megalonyx was, for the most part, probably written during the latter half of January and the first half of February. Having announced his time of arrival in Philadelphia at a

[24] Benjamin Rush to Jefferson, January 4, 1797; with this letter he enclosed a copy of his eulogy "to the memory of our great Republican and philosophical friend Mr. Rittenhouse" that had been delivered before the American Philosophical Society.

[25] Secretaries Magaw, Williams, Barton, and Bleakley to Jefferson, January 7, 1797; printed in *Transactions* **4**: xi–xii, 1799.

[26] Jefferson to the Secretaries, January 28, 1797; printed *idem*, xii–xiii.

[27] John Stuart to Jefferson, January 16, 1797; Stuart said that the missing femur "measured about one foot in length, but one inch and a half thick to the Hollow, which was one inch and a Quarter wide." Jefferson's estimate of the diameter of the thigh bone at 6¼ inches (see note following) could not have been procured from this letter, with its estimate of a diameter of 4¼ inches, for it was not received until February 6, 1797.

[28] Jefferson to Benjamin Rush, January 22, 1797. Jefferson said that these measurements would be incredible were they not under "the jurisdiction of the rule and compass, and of ocular inspection." The measurement of the thigh bone must, however, have been an estimate based on a small fragment of the femur at its lower extremity; in his memoir to the Society Jefferson used 4¼ inches as the diameter of this bone (see foregoing note).

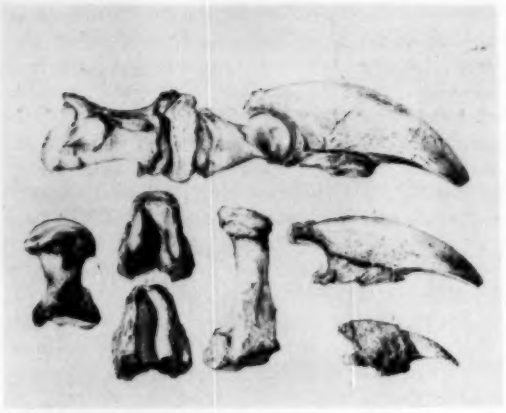

FIG. 1. Toe bones of the megalonyx, as engraved by James Akin to accompany Caspar Wistar's description for the *Transactions of the American Philosophical Society* **4**, 1799.

later date than that planned, he departed from Monticello on February 20 in the hope of getting into the nation's capital "under shadow of the stage and unperceived to avoid any formal reception."[29]

However, the hazards of mid-winter travel were great and he did not arrive until the evening of March 2. A meeting of the Society was scheduled for the next night, but this was "adjourned to the . . . 10th instant particularly, on account of a communication before Mr. Jefferson leaves the city."[30] On the tenth, with the newly elected president in the chair, one of the secretaries read what the minutes describe as "a very interesting memoire 'On the discovery of certain bones of a Quadruped of the ' "—and at this point there is a revealing blank space in the minutes. Two years later, when the fourth volume of the *Transactions* finally appeared, the memoir bore a title that was only slightly more explicit: "On the discovery of certain bones of an animal of the clawed kind in the Western parts of Virginia."[31] With such "victorious evidence" as the bones of the megalonyx in hand, Jefferson dismissed what he regarded as "the weak and untenable" cosmogony of Buffon with finality. "Are we then from all this," he asked after presenting the results of his study of the bones,

> to draw a conclusion the reverse of that of Monsr. de Buffon, that Nature has formed the larger animals of America, like it's lakes, it's rivers and mountains on a greater and prouder scale than in the other hemisphere? Not at all. We are to conclude that she has formed some things large, and some things small on both sides of the earth for reasons which she has not enabled us to penetrate, and that we ought not to shut our eyes upon one half of her facts and build systems on the other half.

This was an eminently reasonable conclusion, but the words become somewhat ironic in view of the fact that they belong rather to the memoir as originally written than to the memoir as read and published. For the fact is that Jefferson had made a significant alteration in his manuscript after arriving in Philadelphia. He had been led to do so by one of those fortuitous accidents that so often rescue the scholarly investigator from error. It was his habit as a traveler, whether in Paris, London, Amsterdam, or Strasbourg, to turn to the bookstores as a first object of interest, and on this occasion, sometime between March 3 and 10, he met with a publication that had only recently arrived from London—the September, 1796, issue of the *Monthly Magazine*.[32] Therein he beheld an engraving showing the fossilized skeleton of an animal recently dug up in Paraguay and mounted in the Royal Cabinet of Natural History in Madrid. (See fig. 2.)

Only a glance was needed to show that, in addition to the inexpert articulation of the skeleton, these were the bones of an animal possessing claws. The skeleton was fairly complete and of

[29] Jefferson to Thomas Mann Ramdolph, Jr., January 22, 1797.

[30] Jefferson was present at the meeting on March 3 and was evidently inducted at that time as president (Minutes of the American Philosophical Society).

[31] *Transactions* **4**: 246–260, 1799. Caspar's Wistar's description of the bones appeared in the same volume accompanied by engravings (for that showing the toe bones, see fig. 1). Wistar's measurements were slightly different from those of Jefferson, owing, as he explained, to the fact that he employed dividers whereas Jefferson used a slip of paper. George Gaylord Simpson, The beginnings of vertebrate paleontology in North America, *Proc. Amer. Philos. Soc.* **86**: 153, 1942, found the objective part of Wistar's paper "so clear, complete, and correct that it has never been significantly bettered for the same or similar objects"; at the same time he said of Jefferson's memoir: "it departs from inaccurate observations and proceeds by faulty methods to an erroneous conclusion." I cannot agree that, as to the objective or even the subjective parts of the two papers, there was so wide a discrepancy, nor evidently did Wistar think that there was.

[32] *The Monthly Magazine, and British Register for 1796* **2**: 637–638. Jefferson's copy of the September, 1796, issue (evidently the only one he possessed) is in the Library of Congress (E. Millicent Sowerby, *Catalogue of the Library of Thomas Jefferson* **1**, No. 682).

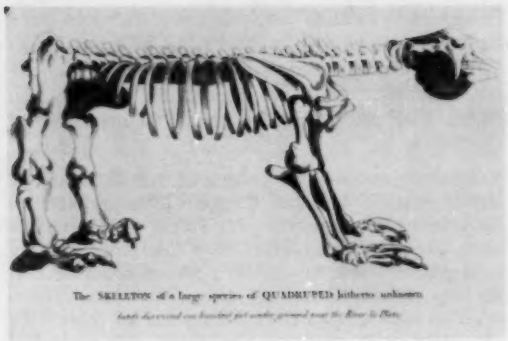

FIG. 2. The megatherium as engraved for the *Monthly Magazine*, September, 1796, from a similar illustration that accompanied Georges Cuvier's *Mémoire sur un squelette fossile*, 1796, that in turn was copied from engravings made in Madrid, *ca.* 1790.

large size, being over twelve feet in length. Moreover, it was boldly labelled as belonging to a "species of guadruped hitherto unknown." The description accompanying the engraving was even more arresting. It was a brief account, but the author called the unknown quadruped *megatherium* and proceeded without hesitation to classify it as related to the sloth and as belonging among the "unguiculated quadrupeds destitute of cutting teeth." For millions of years the bones of the megalonyx and megatherium had lain unnamed and undisturbed on their separate continents. Now, within the space of a single week, they had collided on the streets of Philadelphia, bringing understandable agitation to the president-elect of the Society. The megatherium was unquestionably a large clawed animal, but it was no lion. In the face of this hard, obtrusive fact, Jefferson was obliged to make suitable adjustments in his paper. On the very day of the meeting at which he was to take office as president, present the bones, and listen to the reading of his paper, he wrote an addendum. We can only guess at the pain its composition cost him as he described the article in the *Monthly Magazine* and said that it had come to his attention "after the preceding communication was ready to be delivered in to the Society." He derived what comfort he could from the observation that the engraved illustration of the skeleton of the megatherium was "not so done as to be relied on, and the account . . . only an abstract." But he went on to point out that, with only the leg and foot bones of the megalonyx available, there were "few points for a comparison between them" and that to solve "satisfactorily the question of identity, the discovery of fore teeth [of the megatherium], or of a jaw bone shewing it had or had not such teeth, must be waited for and hoped with patience." In the meantime, he thought it prudent to maintain the difference in name. This much was quite understandable. But the implication in the addendum that the main body of the manuscript had been "delivered in to the Society" as originally written was unwarranted and has proved misleading to scholars to the present time.

For the fact is that Jefferson had fewer doubts after reading the account in the *Monthly Magazine* than his postscript of March 10 suggests; otherwise he would not have surrendered so quickly his own cherished American lion, as he now proceeded to do. With the hour of meeting fast approaching, he went through the whole of his manuscript and made extensive changes. As originally written the opening sentence of the memoir read as follows: "In a letter of July 3. I informed our late most worthy President that some bones of a very large animal of the family of the lion, tyger, panther &c. had been recently discovered within this state." As to the relevant words "the lion, tyger, panther &c." this was a direct quotation from Jefferson's letter to Rittenhouse. Yet even in these words and in many other parts of the manuscript—wherever in fact he had definitely classified the megalonyx with the "family of the lion, tyger, panther, &c."—he made heavy deletions of the uncompromising identification and substituted therefor a safer generalization. As thus amended, the megalonyx became merely an animal "of the clawed kind." This left the door open for members of the cat family, if any lingering hope remained for the monstruous American lion. But the very extensive alterations required in some portions of the manuscript by this retreat to higher ground suggest that Jefferson thought, despite the imperfections of the engraving in the *Monthly Magazine*, that the megatherium would very likely be devoid of the cutting teeth of a carnivore even if the supposedly missing jawbone were discovered and that there was good reason for supposing an affinity to exist between the megatherium and the megalonyx. (See figs. 3 and 4.)

The Society at the meeting on March 10 received the bones, turned them over to Charles Willson Peale with the request that they be put in "the best order, for the Society's use," and

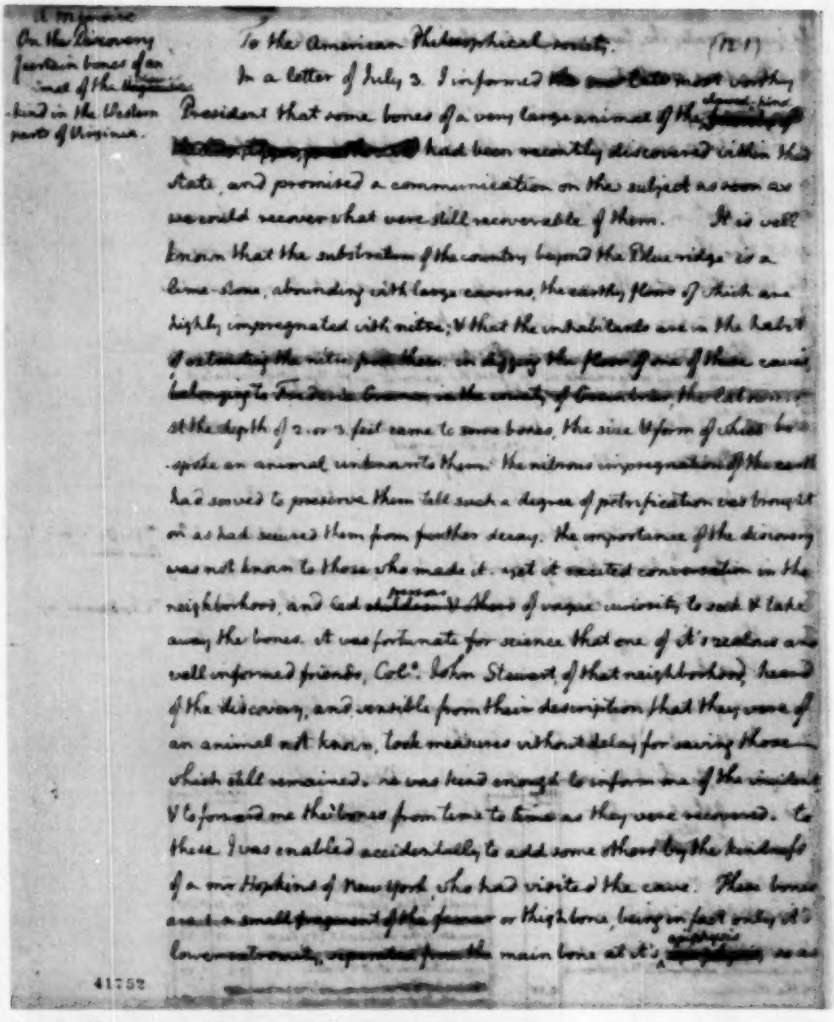

FIG. 3. Manuscript of Jefferson's Memoir showing alterations in that part quoting from the letter to David Rittenhouse, July 3, 1796. Jefferson Papers, Library of Congress.

directed Jefferson's memoir to be put in the hands of the Committee of Selection and Publication with instructions to employ a proper person to execute drawings.[33] The task of describing the bones fell to Caspar Wistar, whose paper with accompanying engravings was also published in the fourth volume of the *Transactions*. Wistar discharged his task so competently that George Gaylord Simpson called his paper "a model of cautious, accurate scientific description and inference, an achievement almost incredible in view of the paleontological naïveté of his associates and of the lack of comparative materials."[34] Simpson correctly portrays the roles of Jefferson and Wistar in this and other instances involving fossil bones, assigning to the former the function of promoting the search for and the procuring of specimens and to the latter that of interpreting them. He also

[33] Minutes of the American Philosophical Society.

[34] Simpson, *op. cit.*, 153; see note 31.

appraised accurately their relative competence in the field of paleontology. Yet he was misled by Jefferson's statement in the postscript to the memoir and thus concluded that the paper had been "published in the original form two years later." This led him to suppose, perhaps because the paper contained comparative measurements of the lion and the megalonyx and many references to the former even after Jefferson's alterations, that its author had categorically concluded that "the bones were those of a great cat, some three times the size of a lion." Jefferson *had* arrived at that conclusion before coming to Philadelphia, but he promptly abandoned it after meeting with the account of the megatherium.

This supposition by Simpson, based upon a natural but erroneous inference, led him in turn into an even more serious error, that is, that in regard to the zoological affinities of the new animal, "Wistar was successful where Jefferson had failed." Considering the two papers as published, this is not a dependable conclusion, for, with one

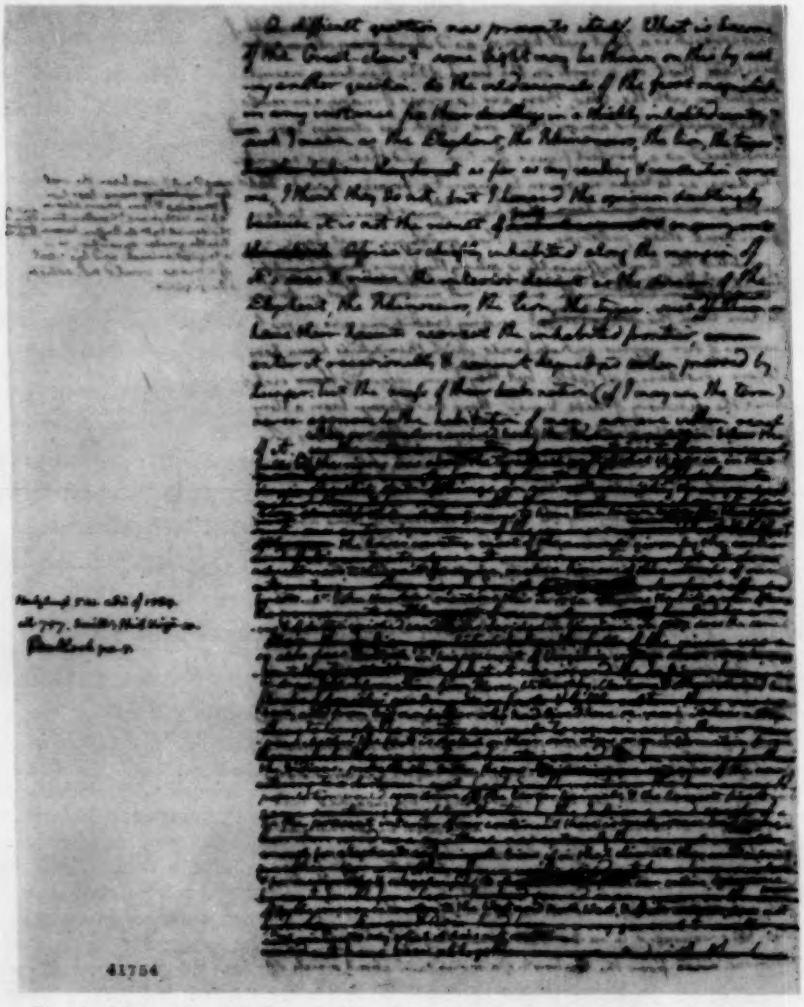

FIG. 4. Manuscript of Jefferson's Memoir showing another considerable alteration in text. Jefferson Papers, Library of Congress.

important exception, both men advised caution and left the question undetermined. In his postscript, as indicated above, Jefferson noted points of agreement between the megalonyx and the megatherium, agreed that the latter was probably not carnivorous, and suggested that the question of identity should await further discovery. Wistar raised the question whether the two animals were related, and concluded that "for want of a good plate, or a full description we are unable at present to decide upon that subject.—If however any credit be due to the representation given in the Monthly Magazine . . . these bones could not have belonged to a skeleton of that animal." [35] This not only cast a shadow of doubt over the authenticity of the account in the *Monthly Magazine* but also was a positive (and erroneous) assertion on the point under discussion, being in that respect quite at variance with the non-committal position taken in the postscript of Jefferson's memoir. It was also at variance with Wistar's own observations earlier in his account, for there he had noted "a general resemblance" between the foot of the megalonyx and that of the sloth (as well as differences in "some important points"). Since the author of the description of the megatherium in the *Monthly Magazine* had categorically related that animal to the sloth, Wistar's observations of the similarities on the one hand and his positive conclusion about the distinctness of the animals on the other present a contradictory and confused result. In extenuation of this conclusion, Simpson observes that available knowledge "of the only previously discovered extinct giant sloth, Megatherium, was limited to one poor illustration. . . . Since 1799 we have learned much more about *Megalonyx* than Wistar knew, but we have not had to correct any essential point in his account." Yet the fact is that, before the papers by Wistar and Jefferson were published in 1799, both were possessed of far more information than has been generally supposed.

Indeed, the author whose work was abstracted by the *Monthly Magazine* had had available to him a similar poor illustration and a far less satisfactory description of the skeleton from Paraguay than was accessible through his genius to Jefferson and Wistar. Yet he had named the animal and classified it with accurate finality. His name was Georges Cuvier, one day to be called the father of paleontology but at this time a brilliant youngster of twenty-seven, eager to begin what was to become a long and notable series of writings on natural history. Cuvier was almost too eager, in fact, and if patriotic pride infused much of Jefferson's effort to rebut the theories of Buffon, so Cuvier's *Mémoire sur un squelette fossile trouvé sur les bords du Rio de la Plata* that had appeared in Paris early in 1796 was not wholly divorced from national feelings. The recently-founded Institut de France was itself largely an expression of resurgent nationalism and it was the instrument through which Cuvier came to make premature publication of a discovery that rightfully belonged to Spanish scientists. A French West Indian official, Philippe-Rose Roume, passing through Madrid in 1795, had chanced upon some proofs of engravings of the skeleton from Paraguay and had sent them to the Institut de France, with which Cuvier had only recently become connected. A brief note by Roume and the proofs of the engravings constituted the sole basis for Cuvier's *Mémoire sur un squelette fossile*. When this was translated and abstracted in the *Monthly Magazine*, therefore, Jefferson and Wistar had the advantage of Cuvier's accurate, authoritative, and final classification of the megatherium.

Cuvier's prior publication was not lost upon Spanish naturalists, who were not without feelings of national pride themselves. Indeed, in respect to the gathering, presentation, and study of specimens of all sorts from various parts of the world, Spain in the last quarter of the eighteenth century had made notable progress. The Real Gabinete de Historia Natural that was founded by Charles III in 1771 had the immense advantage of his royal support. He issued comprehensive orders to all of the Intendants of the provinces of the realm and to the viceroys of the colonies, giving directions particularly to the clergy to search for and send contributions toward the growth and prestige of the museum. The shipments began to flow in to Madrid from all Spanish outposts about the middle of 1777 and continued without interruption to the end of the century. The museum was already distinguished for its flora and fauna when, about 1788, a Dominican named Manuel Torres discovered, on the banks of a creek of the Lujan River near Buenos Aires, the fossil bones of a very large animal. These were promptly shipped to Madrid in seven boxes, where they arrived probably in late September of 1788.[36]

[35] *Transactions* **4**: 531, 1799.

[36] There is doubt as to the date: José Garriga, *Descripción del esqueletto de un quadrupedo muy corpulento y raro*, Madrid, 1796, prologue, states that the shipment ar-

This was a notable acquisition even for a museum that already possessed outstanding collections. It fell into the hands of a competent and wholly appreciative official.

This individual, who has been described as an efficient preparator, an experienced dissector, a good water colorist, and also as being impetuous, somewhat irregular in his work, and of a volatile, temperamental character, was one Juan Bautista Brú y Ramón, who had been connected with the museum since its founding in 1771.[37] Very little seems to be known about him, for he is not noticed in any of the Spanish biographical dictionaries of the early nineteenth century or of the present and he also escaped mention in the standard encyclopedias. The date of his birth is not known and when he died on December 12, 1799, in Madrid the *Annales de Historia Natural* for that and the succeeding year did not record the fact. Yet he was the author and illustrator of the first of an important series of scientific publications of the museum. This was a two-volume work, elaborately illustrated with colored engravings made from Brú's drawings, describing the mammals, birds, reptiles, and fish in the museum's collections, entitled (as to the first volume): *Tomo I de la colección de animales y mónstruos del Real Gabinete de Historia Natural de Madrid, dedicado al Exmo. Sr. Conde de Floridablanca del Consejo de Estado de S.M., y su Primer Secretario de Estado y Gracia y Justicia, por Juan Bautista Brú, pintor y disecador de dicho Real Gabinete y Socio de Merito de la Real Sociedad de Madrid. De orden superior año de 1784.*[38] (See fig. 5.) This

FIG. 5. Title page of the first volume of Juan Bautista Brú's *Colección de animales y mónstruos*, Madrid, 1784. See note 38.

was a publication that, despite its disregard of all systematic grouping of the specimens described, brought some prestige to the author and to the museum among European scientific circles.[39] Its second volume contained an engraving and description of the skeleton of an elephant that had died at Aranjuez, the preparation and mounting of which must have provided Brú with valuable experience for the task of articulating the bones

rived on September 29, 1789. The year, as shown below, is clearly wrong, for Jefferson received Carmichael's letter of January 26, 1789, on April 6, 1789. Agustin Barreiro, in his authoritative *El Museo Nacional de Ciencias Naturales*, 101, Madrid, 1944, says that the bones were discovered in 1788. Since Garriga, who had access to the preparator's papers, was so explicit as to the day and month, I am inclined to believe that he was accurate as to these and erred only as to the year.

[37] For information about Brú, as well as for helpful suggestions and observations, I am greatly indebted to Mrs. Dudley R. Hutcherson, who was in Madrid in 1957–1958 and who not only made extensive searches for information concerning Brú in the libraries, archives, and museums, but also arranged for photographing portions of the works by him and Garriga, discussed above. It was she also who procured the photograph of the megatherium as displayed today in the Museo Nacional de Ciencias Naturales. (See fig. 8.) Much of the information about Brú is drawn from Barreiro, *op. cit.*, 10, 13, 14, 17, 23, 25, 26, 40, 69, 82, 92, 101.

[38] This appears to be a very rare work. No complete copy can be found in the United States. There is in the Library of Congress a fragment without title page, consisting wholly of colored plates numbered from 72 through 195. The work was evidently issued as a collection of plates only as *Colección de láminas que representan los animales y mónstruos del Real Gabinete de Historia Natural de Madrid* (Palau y Dulcet, No. 36258–9; Brunet, 1, col. 1283). In view of Brú's volatile temperament and the evident difficulty he had in getting along with his superior officer, as indicated above, it is difficult to repress the feeling that the face of the lion on the title page of his work is an actual and intended caricature: it (perhaps also some of the other faces of the animals) certainly appears to have a human aspect.

[39] Prologue by Eduardo Hernandez-Pacheco to Marreiro, *op. cit.*, 25.

FIG. 6. Engraving of the skeleton of an elephant mounted and drawn by Juan Bautista Brú. From the second volume of his *Colección de animales y mónstruos.*

of the South American animal. (See fig. 6.) Although vain, indiscreet, and lacking scientific discipline, Brú had done competent work and was perfectly capable of appreciating the importance of the discovery of the megatherium. To him fell the honor of mounting the first fossil skeleton in the world.

It is now known that he set about this task several years earlier than is generally supposed.[40] Indeed, if the date of arrival of the bones in late September, 1788, is dependable, Brú worked so rapidly as to have been able to sketch the almost completely assembled skeleton within four months. Knowing well the importance of the discovery, being cognizant of the honor that would attach to the naturalist who named and announced the fact to the world, and possessing more than a little vanity, Brú set out at once to publish engravings and a description of the skeleton. His ambition was never realized, possibly because of his own shortcomings. In 1794, perhaps after frustrating clashes of personalities within the museum itself, Brú addressed a memorial to the minister, the Duque de la Alcudia, soliciting the appointment as deputy-director of the museum "con derecho a uniforme." This came to the attention of his superior officer, who pronounced Brú's appeal to the minister—certainly an unprecedented action—and his claim to preferment as unjustified and even absurd.[41] It is very likely that, as a result of this and similar indiscretions, Brú severed his connection with the museum, taking with him his drawings, engravings, and description of the skeleton.

Thus when Roume passed through Madrid the following year, it is possible that a disgruntled Brú showed him the proofs, perhaps hoping for publication through the Institut de France. French and Spanish naturalists had been used to such cooperative effort, although this had not failed to produce some frictions between the rival scientists of the two nations.[42] At any rate, whatever the means by which Roume came into possession of the proofs, or for whatever purpose, this effectively gave to Cuvier the opportunity that Brú rightfully had and obviously coveted. When Cuvier's *Mémoire sur un squelette fossile* became known in the Spanish capital in 1796, there was a prompt and emphatic repercussion.

"On my arrival in Philadelphia [in May, for the second time in 1797]," wrote Jefferson to John Stuart, "I met with an account published in Spain of the skeleton of an enormous animal from Paraguay, of the clawed kind, but not of the lion class at all."[43] The book that he saw was a handsome folio volume that had been published in Madrid in 1796. It was José Garriga's *Descrip-*

[40] Simpson, *op. cit.*, 158, gives Brú credit for priority but establishes the date as "in or about 1795"; this is a natural error, for the tablet in the case holding the megatherium in the Museo Nacional Ciencias Naturales bears a similar erroneous date, stating that the mounting of the skeleton by Brú took place "en el año 1796."

[41] Barreiro, *op. cit.*, 35, 69.

[42] For example, on the expedition of Ruiz and Pavon to Chile and Peru (1777–1788), Dombey, a French naturalist, was permitted to join the expedition on condition that he would share with the Spaniards what he found and would not publish in advance. According to Barreiro, *op. cit.*, 82, Dombey landed at Cadiz in 1784, proceeded to France with all of his collections, and immediately began publishing. Dombey, on his side, charged that the Spanish had seized three hundred of his original drawings, had extracted an oath that he would not publish until the expedition returned, and had even set out to assassinate him. He appears not to have published during his lifetime and to have refused even Buffon's entreaties that he do so, regarding himself as bound by a forcibly extracted oath (Alfred de Lacaze, "Joseph Dombey," *Nouvelle biographie universelle* **14**: 479–481).

[43] Jefferson to Stuart, August 15, 1797.

ción del esqueletto de un quadrupedo muy corpulento y raro que se conserva en el Real Gabinete de Historia Natural de Madrid. This was the work that Wistar and Jefferson had expressed a need for: it contained, along with detailed descriptions of the bones, large engravings of the articulated skeleton and of its various parts, after the drawings by Brú. (See fig. 7.) It is dramatic evidence of the alertness to scientific occurrences in Europe on the part of naturalists in Philadelphia that, within a few months of its appearance in Madrid, two copies of Garriga's work were owned by members of the American Philosophical Society. One of these copies belonged to Benjamin S. Barton and the other to John Vaughan, both of them friends of Jefferson.[44] It is not known which of these copies Jefferson saw. It can be safely assumed that Caspar Wistar was also familiar with Garriga's work. Yet Jefferson's memoir and Wistar's description of the bones of the megalonyx, though still almost two years from publication, contain no reference to it. It is possible, since the Society ran off numbers of the *Transactions* as they were received and had in fact printed 150 pages of the fourth volume by the end of 1796, that Jefferson's paper was in print by the time he arrived in Philadelphia the following May. Even though his memoir appears in the middle of the volume (No. XXX), it is not likely that this was the case. Almost certainly Wistar's description was not in print when Garriga's volume appeared in Philadelphia, for it is the very last item in the volume (No. LXXVI).

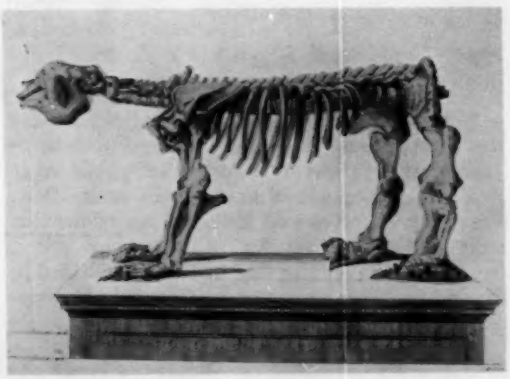

FIG. 7. Engraving of the megatherium from Garriga's *Descripción del esqueletto de un quadrupedo muy corpulento y raro*, Madrid, 1796, printed from the engraving made after Juan Bautista Brú's drawing, *ca.* 1790. Other engravings in this volume show particular members of the skeleton.

Garriga not only defended Brú—calling him "director" of the museum—but also made it quite clear that he felt Spanish scientists if not national honor had been affronted by Cuvier's publication on the megatherium. He stated in the prologue that he had set out at first merely to translate the *Mémoire sur un squelette fossile* into Spanish, but on reading it he learned engravings had been made in Madrid. This led him to Brú and, after considerable persuasion, he was able to induce Brú to sell him the plates, drawings, and description of the skeleton. The impression thus created is that Brú and Garriga had not been theretofore acquainted and that the initiative for a publication proclaiming Brú's prior work rested entirely with the latter. But Garriga's vigor in defending Brú and the not entirely convincing account of the amount of persuasion needed to induce the naturalist to part with his plates and description suggest that this may not be a wholly accurate inference. At any rate, Garriga went on to explain that he had enlarged his original plan so as to include the work of both Cuvier and Brú because that of the former was defective, because Brú was entitled to justice and recognition for what he had done earlier, and because he desired to show that the Spanish nation possessed naturalists who had not been negligent in describing this notable discovery with accuracy and in the greatest detail. He wished particularly to exhibit by way of contrast the mistakes in a notice issued by a foreigner before a more exact account, projected earlier, could be published in Spain. Inspired with these patriotic motives, he aimed another barb at Cuvier: this extraordinary animal, he declared, could not be classified with certainty, owing in part to the fact that two other less complete skeletons had not been promptly and carefully described.[45] Until further discoveries and descriptions of them should become known, Garriga, disdainfully rejecting Cuvier's classification and even the name megatherium, thought that Brú's

[44] Evidently these are yet the only two copies of the work to be found in the United States. Vaughan's copy was presented to the American Philosophical Society in 1818. Barton's library was acquired by the Pennsylvania Hospital in 1829 and the copy of Garriga's work was known to be in that collection some years ago but has since disappeared. The Society's copy is the one from which fig. 7 is taken.

[45] These skeletons were also found in South America, but were far less complete than the one mounted by Brú.

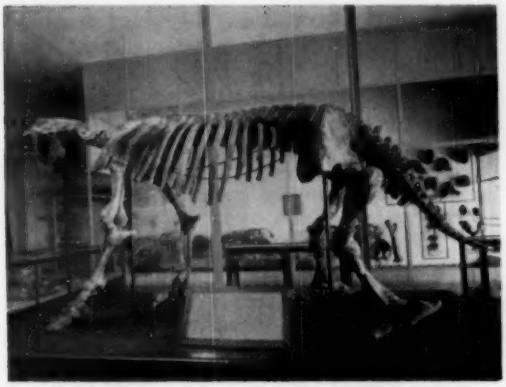

FIG. 8. The megatherium as mounted in the Museo Nacional de Ciencias Naturales (1958).

engravings and description would present to naturalists the best information available to that time. The words of seeming scientific caution, echoing those of Jefferson and Wistar in America, were alloyed with the alien spirit of nationalism.

This indirect assault on Cuvier's slender pamphlet was repeated elsewhere, particularly in northern Europe. But one by one the hostile voices became silent. Cuvier, who never saw the skeleton, was wholly accurate in his quick identification and the name that he gave to it has survived. In the 1823 edition of his great work, *Recherche sur les ossemens fossiles,* he made handsome amends to Brú and complimented the Spanish naturalist as one who had set an example for Peale with the mastodon [46] and for Adams with the elephant. He declared that the pains taken by Brú in mounting the skeleton of the megatherium had made it possible for this rarest and most recently-discovered fossil animal of great size to be the first to have its osteology fully known.[47] The officials of the Museo Nacional de Ciencias Naturales, where the skeleton is still to be seen (see fig. 8), have had the wisdom to preserve it substantially as Brú mounted it, thus giving a deserved permanence to the quality of his pioneering achievement.[48]

If Jefferson had been less concerned with the Scottish threshing machine or with the tense electioneering in the summer and fall of 1796, he might have remembered a manuscript among his papers at Monticello that would have spared him the agitation of changing his manuscript on the eve of his induction as president of the Society. Indeed, with that manuscript he could have anticipated Cuvier, for he had had it in his possession and had known about the skeleton from Paraguay a full six years before Roume sent Brú's engravings to the Institut de France.

In the spring of 1789, as Jefferson sat in the Hôtel de Langeac in Paris, surrounded by boxes of furniture, books, papers, and luggage packed ready for departure to America the moment he received permission from Congress—which was daily expected but did not arrive for another four months—he received a letter from William Carmichael, American chargé d'affaires at Madrid. In it was a drawing of a large animal lately dug up in Paraguay, together with a descriptive sketch written in broken English. There was a drawing of one of the glyptodonic molars and exact measurements of various members: even thirty-five years later Cuvier could only make estimates of measurements from engravings because no published description of the skeleton contained such precise information as was made available to Jefferson in this earliest drawing and description of the megatherium. (See fig. 9.) These, Carmichael wrote, were for his own information since "the Academy of Natural history here, will soon publish an account of this Animal and the person who furnishes me with the inclosed Sketch and notes desires that his Observations should not be made public." [49] Jefferson thanked Carmichael

[46] Peale's mastodon "was the first fossil skeleton to be mounted in America and the second in the world" (Simpson, *op. cit.,* 160).

[47] Cuvier, *op. cit.* **5**: 174–191, at p. 174. Cuvier admitted that his original *Mémoire* had been published with "une mauvaise copie de la figure du squelette" (p. 175).

[48] *Boletín,* Sociedad Española de Historia Natural, May, 1903, gives an account of the mounting of the megatherium and of the extent to which Brú's work has been preserved. The skeleton has been dismantled several times for moving from one museum housing to another; substitute parts made by Brú of cork are still in use, though the present wrought-iron mountings are new, most of the old ones having been lost or misplaced. Señor Vidal-Box, who with Eduardo Hernandez-Pacheco had the task of remounting the specimen in 1950, carefully studied Brú's engravings in order, as faithfully as possible, to mount the skeleton according to the original design, even to the extent of repeating Brú's errors (from a communication of Mrs. Dudley R. Hutcherson, March 21, 1958, after consulting with Señor Vidal-Box).

[49] Carmichael to Jefferson, January 26, 1789. The description is published as an enclosure to Carmichael's letter in *The Papers of Thomas Jefferson* **14**: 504–505. The handwriting of the descriptive notes and on the drawing (which is the same) has been checked with the few remaining specimens of Brú's handwriting, and, while there are similarities, it is not certain that Brú actually transcribed the notes, though he probably did.

for these "interesting papers," packed them away in the growing mountain of luggage, and resumed the long wait for his congé, during which he wrote his remarkably perceptive communications on the unfolding events of the French Revolution. He was in communication with some of the principal members of the Académie des Sciences at this time, but despite this and the fact that fossil bones—especially those from the Western hemisphere—enlisted his keen interest, Jefferson evidently made no communication of the discovery to his scientific friends. He brought the drawing and sketch back to America in the autumn of 1789 and they have remained among his papers ever since. Thus, all during 1796 they were within arm's reach in his notable library and personal archive at Monticello. Not once then, or apparently ever, did Jefferson remember them. If he had been a Cuvier, he could have named the megatherium in 1789 and, even better, he could have avoided a different name for the bones excavated in Virginia.

But the fact that he did describe and name the megalonyx gave Cuvier the opportunity to pay this graceful tribute to the larger and more significant meaning of Jefferson as a scientist:

> M. Jefferson . . . dont les vertus et les talens on fait le bonheur du peuple qu'il gouvernoit et l'admiration de tous les amis de l'humanité, et qui joint à ces qualités superieures un amour éclairé et une connoissance étendue des sciences auxquelles il a procuré de notable accroissemens, est le premier qui ait fait connoitre cette interessante espèce d'animal fossile.[50]

Thus, through a strange coincidence, Jefferson helps us to add another bit to the growing evidence that Spain in the eighteenth century was not, as generally supposed, an island altogether untouched by the tides of the Enlightenment. His very lapse demonstrates that science then, with better justification than now, was affected in its progress by national allegiances. Most important of all, it reveals Jefferson himself. When, some years later, the president of the American Philosophical Society was also president of the United States, the floors of the White House were piled high with fossil bones from the western regions. The authors of *Thanatopsis* and of *The Night before*

[50] Cuvier, *op. cit.* **5**: 160.

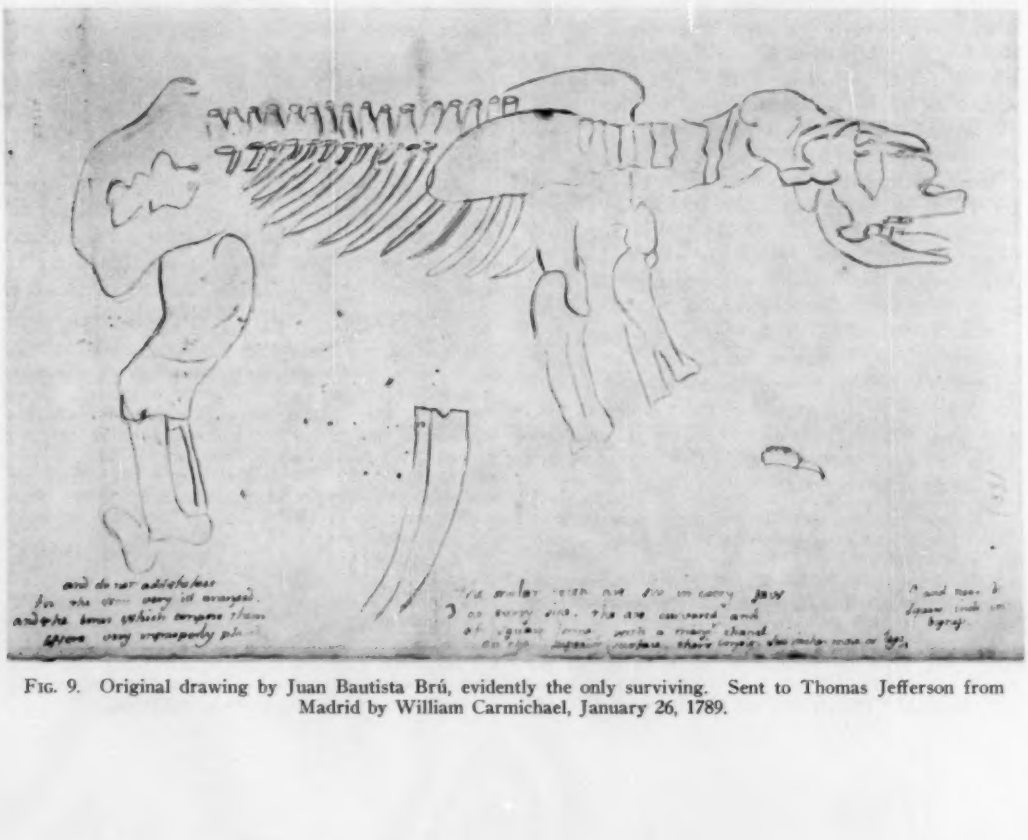

FIG. 9. Original drawing by Juan Bautista Brú, evidently the only surviving. Sent to Thomas Jefferson from Madrid by William Carmichael, January 26, 1789.

Christmas could ridicule and rail against his interest in such matters, proclaiming them to be subversive of religion and dangerous to youth. But Jefferson had remained steadfast in his defense of free inquiry, unintimidated by attacks from press and pulpit upon his zeal for the advancement of knowledge. The nation had responded to such a champion. "Of all the charges brought against me by my political adversaries," Jefferson declared, "that of possessing some science has probably done them the least credit. Our countrymen are too enlightened themselves to believe that ignorance is the best qualification for their service." [51] This confident affirmation, generously flattering to his countrymen, suggests that the greatest of his contributions to science was his advocacy of the free-ranging mind as the first of requisities for a self-governing society. In the final analysis, Brú's drawing of the megatherium was probably blotted from memory in 1796 by what Jefferson thought he observed on the horizon in the ambitious figure of Alexander Hamilton, advocate of a political system opposed to one that afforded the people a glimpse of the unlimited advancement awaiting them through the magic doors of science. Jefferson's defects as a scientist mirror his greatest achievements as a legislator.

[51] Jefferson to Charles F. Welles, December 3, 1809.

THE GALLATIN PLAN AFTER ONE HUNDRED AND FIFTY YEARS

CARTER GOODRICH

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(*Read April 26, 1958*) *

In April, 1808, just one hundred and fifty years ago, Albert Gallatin, Secretary of the Treasury, presented to the Senate his notable report on "Roads and Canals." [1] Since he was a member of the American Philosophical Society for fifty-eight years,[2] it may seem appropriate for us to celebrate the sesquicentennial of his Report. I doubt very much that anyone thought to commemorate its centennial. Fifty years ago, interest in anything like economic planning, or in government as an agency of economic development, was at a low ebb in American thought. Now the climate of opinion has somewhat altered. The current interest in planning for the economic development of the poorer nations of the world, and the recognition of the importance in such planning of what it is now the fashion to call "public overhead capital," make it easier for us to appreciate the quality of Gallatin's proposals for a system of transportation for what was in his time our own new and developing nation.

The Report may be considered both as geography and as politics. As the former, its purpose was to identify the points at which improved transportation would be of particular national importance. The two main problems were those of better communications along the seaboard and of access to the interior west of the Appalachian barrier. His principal proposals, which were, as he said, "based on the great geographical features of the country," are represented by the arrows on the accompanying map. In addition to the construction of a great turnpike from Maine to Georgia, a sort of U. S. Route Number One, he advocated the cutting of canals across four small "necks of land"—Cape Cod; New Jersey between the Raritan and Delaware Rivers; the peninsula between the Delaware and Chesapeake Bays; and "the marshy tract which divides the Chesapeake from Albemarle Sound." Less than a hundred miles of canal, he said, would give the nation an inland navigation, along the greater part of the coast, protected against "storms and enemies" and therefore useful "in peace and war."

The greater and more difficult problem was that of the Appalachian Barrier. For this Gallatin proposed two solutions. Since the Hudson was the one river that broke its way through both the great ranges of mountains, its valley and that of the Mohawk provided openings to the lakes and to the St. Lawrence that should be exploited by canals. Farther south, the Barrier was too formidable for canals, at least "in the present state of science"; but points of attack could be found where the headwaters of western and eastern rivers came close together. He identified four such pairings of rivers—the Allegheny and either the Susquehanna or its tributary, the Juniata; the Monongahela and the Potomac; the Kanawha and the James; and the Tennessee and either the Santee or the Savannah. In each of these cases, navigation should be improved on the eastern river, and it should be connected with the western stream by a good mountain road.

A partial test of Gallatin's geography may be made by comparing his proposals with the major improvements actually constructed on the routes which he indicated (see map 1 and table 1). Of the four "necks," all were ultimately cut by canals. The Delaware and Raritan was later abandoned, but the Cape Cod Canal remains in operation and the Chesapeake and Delaware and the Dismal

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[1] *American State Papers, Class I, Miscellaneous* **1**: 724–779. The Report proper, from which all the quotations are taken, is on pp. 724–741; the rest is Appendix.

[2] From January 21, 1791, when he was a member of the Pennsylvania House of Representatives, to his death on August 13, 1849. The records of the Society include a letter dated May 22, 1843, in which Gallatin at the age of eighty-two expressed regret that "vacillating health" prevented his attendance at the hundredth anniversary of "the oldest and most distinguished Scientific Association of America."

Swamp form part of an even longer Intercoastal Waterway than Gallatin envisaged.

The Northern Opening was exploited by the Erie Canal, which improved on Gallatin's proposal by taking the whole distance to Lake Erie in one great sweep instead of two shorter ones, as well as by the Champlain and Oswego Canals. Somewhat later, it provided the "water-level route" of the New York Central Railroad. Of the four pairs of rivers, the first was exploited by the Pennsylvania State Works—with their "amphibious" combination of railroad-canal-mountain railroad-and-canal—and later and more successfully by the Pennsylvania Railroad. The Potomac route was taken by the National Road, and later by the Chesapeake and Ohio Canal, which did not cross the mountains, and by the Baltimore and Ohio Railroad, which did. Thus three of the four trunk line railroads built through to the Middle West before the Civil War followed Gallatin's routes, and the one exception was the much less successful Erie Railroad.

Farther to the South, exploitation of the third pair of rivers was begun by the James River Canal and the Kanawha Turnpike; and it was more fully accomplished, though not till after the Civil War, by the completion of the Chesapeake and Ohio Railroad. For the final pair of rivers, the story is a different one. This area differs from the three others, though Gallatin did not say so, in that no river cuts a path through the steep eastern barrier of the Blue Ridge.[3] The last antebellum attempt to carry a railroad across it came to a halt in a still unfinished tunnel cut into the granite of Stumphouse Mountain,[4] and the connection made in the eighteen-eighties by way of Asheville and the French Broad River never became a major artery of traffic.[5] Instead, the decisive passage of the Southern Appalachian barrier was made farther to the west, where the mountains were lower, by Georgia's state railway built from Atlanta to Chattanooga on the Tennessee. This represents the widest of the actual deviations from the routes so prophetically outlined by Gallatin in 1808.

The Report was less successful in political than in geographical diagnosis and prediction. What it proposed was a Ten-Year Plan of concerted national action. In a new country with sparse population and a scarcity of capital, the necessary improvements could not "be left to individual exertion" without public aid. Moreover, some of the most important works would become productive only when an entire line of connecting improvements was completed. "The General Government," said Gallatin, "can alone remove these obstacles" to progress. It might do so either by direct construction on its own account or by entering into partnership with private companies. A sum of twenty million dollars, expended over ten years, would provide the works of major national importance and even permit some expenditure—on grounds of "policy no less than justice" —on more local projects in states less directly affected by the larger undertakings. Since payment of the national debt had almost been completed, the federal revenues could support the program without the necessity of additional taxation.

Let us again compare the planning with what was actually done. The Report called for improvement by concerted plan; actual construction proceeded on a piecemeal basis. The Report called for completion within ten years; actual construction took many decades. The Report called for federal action, but most of the improvements were built by other agencies.

The dates of completion and, where appropriate, abandonment of the improvements are indicated on the table. The first major canal, the Erie, was completed in 1825. Railways had of course to await the processes of invention and innovation. Most of the undertakings listed were finished within a span of fifty years from the date of Gallatin's Report; but the Chesapeake and Ohio Railroad did not reach the Ohio River until 1873, and the Cape Cod Canal was not opened until 1914.

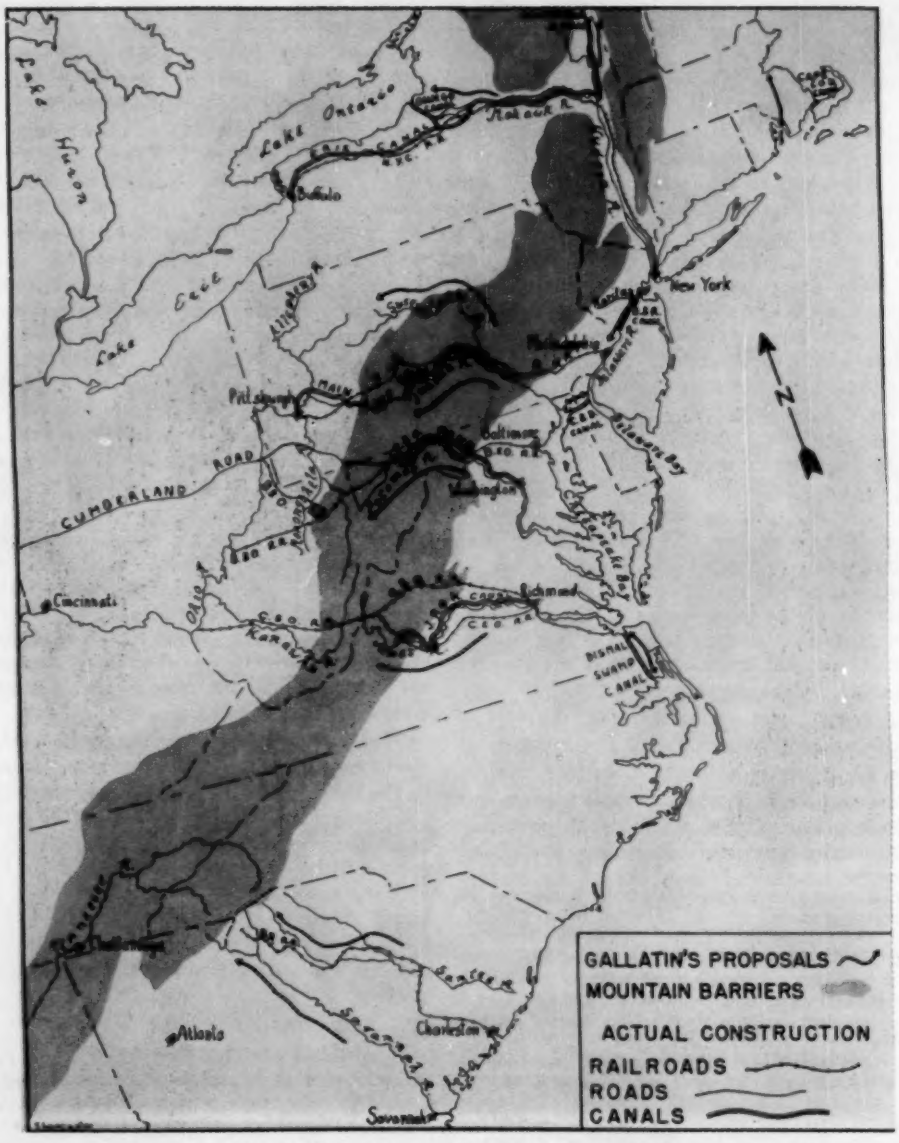
Gallatin proposed that the work be done either by the federal government directly or by the federal government in partnership with private enterprise. Yet, of all these undertakings, the only one completed on federal account was the National Road, which had already been authorized when

[3] For a geographer's statement of the importance of such cross-mountain, or, as he calls them, "dioric" streams, see Edward L. Ullman, *American commodity flow*, 4, Seattle, Univ. of Washington Press, 1957. For discussion of the economic significance of the early transportation routes, see Abraham H. Sadove, Transport improvement and the Appalachian barrier, unpublished dissertation, Harvard Univ., 1950.

[4] The 5,000-foot hole in the mountain is now used by Clemson Agricultural College in the production of blue cheese.

[5] This is today the route, still single track, of the Southern Railway's "Carolina Special" from Cincinnati to Charleston.

the Report was written. The method of federal partnership by stock subscription was applied in the cases of the small Chesapeake and Delaware and Dismal Swamp Canals and in the larger but less successful Chesapeake and Ohio Canal, though in this last case most of the burden was finally carried by the state of Maryland. The chief rival agency was not, as might be supposed today, unaided private enterprise. Of all the improvements listed, only the Delaware and Raritan Canal, built to exploit the obvious opportunities of trade between New York and Philadelphia, and



MAP 1. Gallatin's proposals and actual construction.

TABLE 1

GALLATIN'S PROPOSALS AND ACTUAL CONSTRUCTION

Gallatin's proposals	Actual construction	Agency	Year completed	Year abandoned
The Four Necks of Land				
(1) Cape Cod	Cape Cod Canal	Private	1914	—
(2) New Jersey	Delaware and Raritan Canal	Private	1834	1933
(3) Delaware and Chesapeake Bay	Chesapeake and Delaware Canal	Mixed (federal, state, private)	1830	—
(4) Chesapeake Bay to Albermarle Sound	Dismal Swamp Canal	Mixed (federal, state, private)	1828	—
The Northern Opening				
Hudson to Lake Champlain	Champlain Canal	State	1823	—
Mohawk to Lakes Ontario and Erie	Erie Canal	State	1825	—
	Oswego Canal	State	1828	—
	New York Central Railroad	Mainly private[a]	1841–1851[d]	—
The Four Pairs of Rivers				
(1) Allegheny-Juniata, Susquehanna	Main Line—Pennsylvania State Works	State	1834	
	Philadelphia & Columbia R. R.			—
	Susquehanna and Juniata Divisions (Canal)			1901
	Portage Railroad			1857
	Western Division Canal			1865
	Pennsylvania Railroad	Mixed (local government, private)[b]	1855[c]	—
(2) Monongahela-Potomac	National (Cumberland) Road	Federal Government	1818[e]	?[g]
	Chesapeake & Ohio Canal	Mixed (federal, state, local government, private)	1850	1924
	Baltimore & Ohio Railroad	Mixed (state, local government, private)	1853[e]	—
(3) Kanawha-James	James River & Kanawha Canal	Mixed (state, local government, private)	1851	1880
	Chesapeake & Ohio Railroad	Mixed (state, local government,[e] private)	1873[e]	—
(4) Tennessee-Savannah, Santee	Blue Ridge Railroad	Mixed (state, local government, private)	1861[f]	—

[a] Local aid between Albany and Schenectady.

[b] Philadelphia & Columbia section purchased from state.

[c] Two of its components, the Blue Ridge Railroad (of Virginia) and the Covington & Ohio, were built as state works. The state's interest was sold to private purchasers before the railroad was completed to the Ohio River.

[d] 1841, Albany to Buffalo. 1851, Hudson River Railroad from New York City. New York Central Railroad formed by consolidation in 1853. River at Albany not bridged until 1866.

[e] To Pittsburgh; Wheeling; and Huntington, W. Va. respectively.

[f] Further work abandoned.

[g] No significant date can be assigned. Different sections of the road fell into disuse at different times. The present U. S. Route 40 follows much of its course.

the Cape Cod Canal, built in the twentieth century and later purchased by the federal government, received no public funds for construction. It should, however, be added that the series of small lines that became the New York Central Railroad, and that took advantage of the most nearly level route to the interior, received a minimum of public assistance and indeed faced the obstacle of early restrictions imposed by the state.[6]

The principal methods employed were those of state and mixed enterprise. The former had its great triumphs in New York's Erie Canal and—outside Gallatin's routes—in Georgia's state railroad, the Atlantic and Western.[7] One of its less happy instances was that of the state works of Pennsylvania. Most common of all was the method of mixed enterprise, in its variety of forms and combinations. Its two greatest ante-bellum achievements were the Pennsylvania and the Baltimore and Ohio Railroads, each of which reached the Ohio in the eighteen-fifties with funds derived almost equally from public and private sources. In the event, then, the conquest of the Appalachian Barrier was accomplished not by federal action, as Gallatin proposed, and for the most part not by purely private enterprise. If the methods adopted represented a victory of competition over national planning, this was only in part the business competition of individual promoters and investors. It

[6] Several of the companies received state aid, but apparently none spent it on what is now the main line. The Mohawk and Hudson was aided by the city of Albany. Alvin F. Harlow, *The road of the century. The story of the New York Central*, ch. 3, esp. p. 57, New York, Creative Age Press, 1947. Harry H. Pierce, *Railroads of New York. A study of government aid, 1826–1875*, esp. Appendix Map 2 and Appendix Tables 1 and 2, Cambridge, Harvard Univ. Press, 1953.

[7] Milton Sydney Heath, *Constructive liberalism. The role of the state in economic development in Georgia to 1860*, ch. 11, Cambridge, Harvard Univ. Press, 1954.

was in still greater degree a civic competition, an "emulation of states and cities," in their rivalry for glory and for the commerce of the West.

If we ask why the Gallatin Plan was rejected in favor of this less orderly, piecemeal approach, a part of the answer is easily found. The surplus revenues on which the Secretary of the Treasury based his program began to disappear almost at once as the Embargo Act and the War of 1812 reduced trade and revenue and required great increases in military expenditure. Under these circumstances, the Congress was not willing to support, nor the Administration to press, a great program of public works.[8] It is more difficult to explain why the proposals were not carried out when circumstances again became favorable, and when the program was revived and even elaborated by John C. Calhoun and John Quincy Adams. A full answer would require too long an excursion into a much-debated area of political history;[9] but two conclusions, one negative and one positive, seem to emerge from the facts already presented. The first is that the national program was not defeated by the influence of private individuals anxious to build the improvements themselves for their own profit and to do so without aid and without interference. The issue was not like that of the contest in our own time over Hell's Canyon, in which advocates of public power were arrayed against advocates of private power and a great corporation stood ready to exploit the hydroelectric resources of the Snake River. In Gallatin's time, American private capital and business organization were not yet strong enough to undertake the major enterprises, and they had no desire to shoulder the full cost and risk of developmental undertakings of which the gains would be slow to come and hard to capture.

The second conclusion is that agreement on a concerted national plan of action was prevented largely by the fervor of the state and local patriotisms to which I have referred. Conflicting states' interests were associated with, and sometimes expressed in, the constitutional doctrine of states' rights; and, as the period advanced, agreement was made still less likely by the hardening of the sectional division between the North and South. The final paragraph of Gallatin's Report expressed confidence in the capacity of the "National Legislature" to select truly national objects for improvement, describing the Congress as "embracing every local interest, and superior to every local consideration." The debates on internal improvements more often illustrated the first than the second half of this description, and state and local considerations proved too strong for the adoption of a national program.

There remains one final question: What could the planners for the less developed countries learn from this experience, and how would they be likely to regard it? Most of them, I suspect, would be inclined to prefer the orderliness of Gallatin's Plan to the strange miscellany of measures that were actually adopted. Certainly there was waste and inefficiency in the American process. A number of the competitive enterprises in rival states stimulated by the opening of the Erie Canal were characterized by misjudgment of the geographical possibilities or by hasty and unwise choice of means.[10] In some cases the efforts were devoted to ends that now seem as remote as George Washington's earlier dream of making Alexandria a great Atlantic port or North Carolina's belief that building an east-west railroad would make Morehead City into another Baltimore or Philadelphia.[11]

On the other hand, this disorderly American process exhibited certain elements of strength which planners for the less industrial nations would do well to understand. In the first place, it drew into the developmental undertakings the energies of private enterprise and capital which at a later state were able to take over the entire responsibility for railroad construction. In the second place, it drew into the effort the great energies of state and civic patriotism. A student from a developing country recently expressed surprise

[8] Raymond Walters, Jr., *Albert Gallatin, Jeffersonian financier and diplomat*, esp. ch. 16, N. Y., Macmillan, 1957.

[9] Carter Goodrich, National planning of internal improvements, *Polit. Sci. Quart.* **62**: 16–44, March, 1948. Joseph Hobson Harrison, The internal improvement issue in the politics of the Union, 1783–1825, unpublished dissertation, Univ. of Virginia, 1954.

[10] A contemporary put the point as follows: "The successful results of one of these projects, under circumstances favorable beyond example, has set the nation wild, without any regard for the analogy of the cases, or the obstacles which nature has placed in their way." "Jerseyman" in Trenton, N. J., *Federalist*, Dec. 17, 1827, cited in H. Jerome Cranmer, The New Jersey canals, unpublished dissertation, Columbia University, 1955. Pennsylvania's choice of methods will be discussed in Julius Rubin's dissertation, Imitation by canal or innovation by railroad, now in preparation at Columbia University.

[11] Cecil Kenneth Brown, *A state movement in railroad development*, esp. chs. VII and XV, Chapel Hill, Univ. of North Carolina Press, 1928.

that local authorities should have had the legal power to engage in developmental undertakings. He might also have expressed surprise at the enthusiasm which they devoted to them. Both factors, the decentralization of political authority and the strength of the "booster" spirit of states and localities, have been—I believe—unique in the American case. The leaders of the less industrial nations would be fortunate if they could enlist such strong civic, as well as individual, energies in the effort for economic development. In most cases, however, it appears that they will be more determined than we were to bring such efforts, private as well as public, within the guiding lines of concerted national programs. If so, let us hope that their plans may have the breadth of view and the philosophical quality of the one framed by Albert Gallatin one hundred and fifty years ago.

CAN VIRUSES BE MANAGED?

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(*Read April 25, 1958*)

If we are to find an answer to the question "Can viruses be managed?" we must learn what sort of things viruses are. During the last six years some astonishing discoveries have been made. It is now quite clear that viruses are uniquely different from all other infectious agents. The history of ideas about them is brief. Almost all of it is a product of this century; the more significant episodes have evolved since 1935. Viruses first were thought of as contagious living fluids that induced infectious diseases (4). Later they became submicroscopic agents of unknown nature (24, 35). By 1935 some were regarded as huge molecules which could be crystallized and were capable of reduplication (28). With the electron microscope it became obvious that viruses were discrete particles of definite form and composition (34). Recently a dramatic change has occurred and they are thought of as vehicles for the transmission of nucleic acids which initiate infection (14).

The idea that a chemical substance, even a large one in molecular terms, could be infective was a revolutionary concept. The germ theory did not prepare biologists for the finding that an infectious agent could exist as a three-dimensional crystal (3). That an infectious disease could be induced by a molecule of nucleic acid (12, 10) weighing no more than three million hydrogen atoms was a concept almost as full of implications for biology as was the discovery of radioactivity for physics.

How many viruses there are, no one knows. As many as a thousand have been recognized; more than sixty virus diseases of man are known. A condition for their recognition is the production of damage in a living thing, and so no harmless virus has been found. Viruses are designated as of plant or animal origin, depending on the kingdom of things they most damage. Bacterial viruses are distinguished from viruses of other plants. Insect viruses are distinguished from those of other animals. These distinctions have more than taxonomic significance.

When viruses are released from the cells in which they multiply, they have a definite physical form (30). A few examples are illustrated in figure 1. The approximate form and size of some well-known virus particles representative of the four main groups are indicated. The reference scale is one ten-thousandth of a millimeter. The plant virus, tobacco mosaic, is a rod much longer than it is thick (29). The bacterial virus is a spermlike object with a polygonal head and a tail (22). All bacterial viruses, but not any others, have tails (31). The animal virus, influenza, is spheroidal (23). The insect virus is a polyhedron (33). Other viruses in each of the four groups are not always similar in form and, in addition, they may differ considerably in size.

Techniques are more advanced with bacterial viruses than with others. It is now feasible to examine what occurs when one virus particle infects a single bacterium. An example is illustrated in figure 2. The virus attaches by the tip of its tail (1) and then disappears. It can't be found even though the bacterium is broken open (9). At about fifteen minutes, the bacterium appears normal but it cannot divide. The lost virus particle still cannot be found. At about thirty minutes, new viruses appear in the cell. Then the bacterium bursts and releases about one hundred virus particles (8). The cell has been driven to commit suicide in supporting virus reproduction. Each new particle can repeat the cycle when it finds a suitable bacterium. One virus can lead to the production of ten billion new particles in about three hours. In the process about one hundred million bacteria are destroyed.

The chemical composition and the arrangement of the components is known for a number of viruses. A representation is shown in figure 3. Tobacco mosaic is composed solely of protein and nucleic acid (2). The protein consists of a hollow tube and surrounds a core of ribonucleic acid (RNA) (11). The bacterial virus also is composed of protein and nucleic acid. The protein forms the walls of the head and tail. The nucleic acid, of the deoxyribose type (DNA), is located

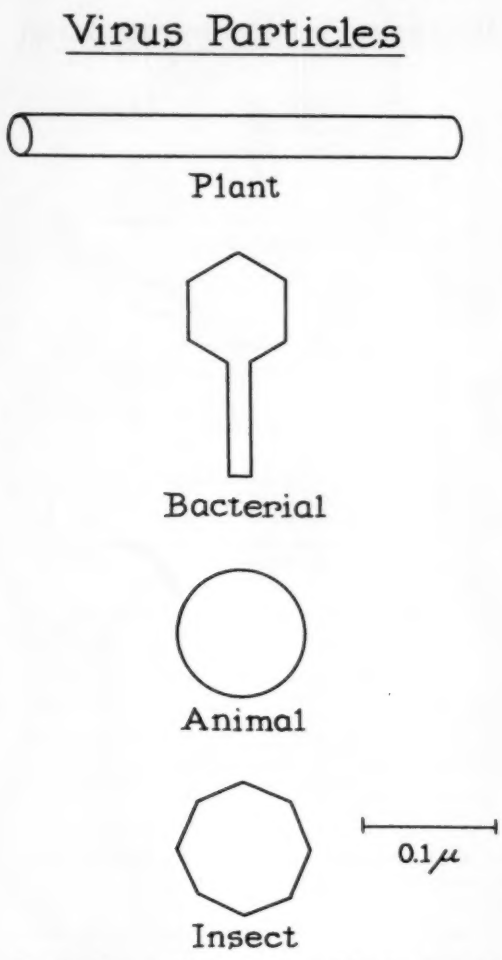

FIG. 1. Some well-known virus particles that are representative of the four main groups of viruses. The plant virus is tobacco mosaic; the bacterial virus T2; the animal virus influenza and the insect virus one from the crane fly.

in the head (15). Animal viruses are more complex. They consist largely of protein and nucleic acid but may contain lipid and some carbohydrate. The nucleic acid is usually of the ribose type (RNA); a few contain DNA (21). The nucleic acid is also centrally located (26). Insect viruses are composed chiefly of protein and nucleic acid of the deoxyribose type (5). In each of the four groups of viruses the centrally placed nucleic acid is surrounded by a coat of protein which protects the delicate and unstable genetic material.

Current ideas about the reproduction of viruses emerged only six years ago. They came from the startling discovery of Hershey and Chase (14) that a bacterial virus acts like a disposable micro-syringe and injects its nucleic acid into the bacterial cell. The particle itself does not enter. With this now classical demonstration, the primacy of nucleic acid in virus reproduction first became clear.

A representation of bacterial virus reproduction is shown in figure 4. The particle attaches and the tail punches a hole in the bacterial wall (32). The nucleic acid in the head is ejected into the bacterium. The DNA directs the metabolic machinery of the cell so that it ceases to make bacterial components and produces virus components. This goes on even if the head and tail are removed (14). The nucleic acid acts as a new chromosome and overrides the genetic material of the cell. It directs the production of more nucleic acid like itself and new virus protein. These components are produced separately, not as new particles (16). Head and tail structures are

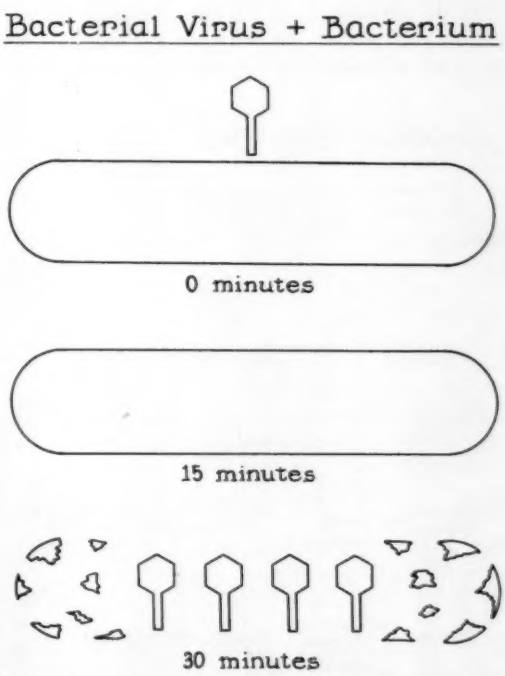

FIG. 2. Schematic representation of certain events which follow the infection of a bacterial cell by a bacterial virus.

formed and these subunits are finally assembled into intact particles. Once the nucleic acid is in the head the particle can infect another bacterium and can initiate a new reproductive cycle. This entire process can be completed in less than twenty minutes and is one of the most rapid and productive in biology.

Clearly the intact particle does not participate in reproduction. Only the nucleic acid is needed to set the cell's machinery in new directions. The tiny particle with its tail can be considered a vehicle which transports special nucleic acid from one bacterium to the next and provides an efficient means for its penetration.

This suggested that nucleic acid, separated from the particle, might itself initiate reproduction. About two years ago Geirer and Schramm (12) in Germany and Fraenkel-Conrat (10) in this country showed that isolated nucleic acid of tobacco mosaic is infective. In the past year similar results were secured with several animal viruses (6), including poliomyelitis (7), and there is now no reason to doubt that naked nucleic acid is infective and can induce virus reproduction.

In the case of tobacco mosaic virus the thread-like nucleic acid is extruded from the protein coat by gentle chemical treatment (13). It is released as a definite structure, not a formless substance. The naked nucleic acid is unstable and must be manipulated with care (27). As shown in figure 5, the nucleic acid enters the cell and orients the metabolic processes so that virus components are produced. After the synthesis of nucleic acid and protein coats, virus rods are assembled and released from the cell. Clearly the cycle is similar to that illustrated for bacterial viruses. The difference is that it was initiated by a chemical substance, not a virus particle.

Studies by Hoyle and Finter (20) in England and Schäfer (25) in Germany show that animal viruses utilize a similar mechanism. A diagrammatic schema is shown in figure 6. The spheroidal particles contain subunits enclosed in a membrane. The central subunit is composed of ribonucleic acid and protein. The others are made up of

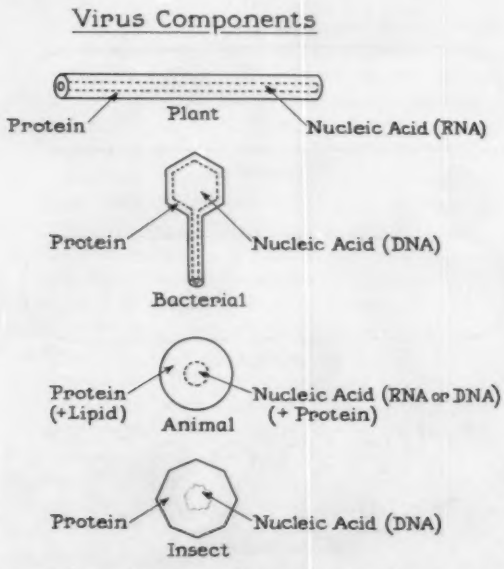

FIG. 3. Chemical composition of and arrangement of components in some well-known virus particles. The viruses correspond to those illustrated in figure 1.

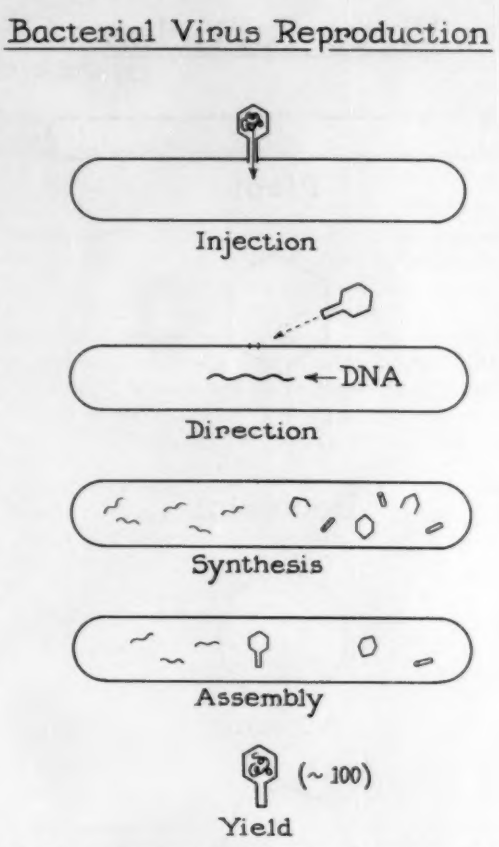

FIG. 4. Diagrammatic representation of certain events in bacterial virus reproduction in a bacterial cell.

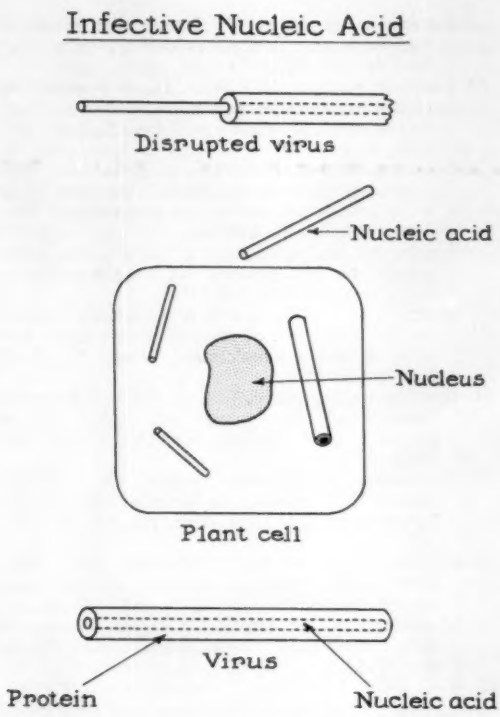

FIG. 5. Schematic representation of initiation of plant virus reproduction in a plant cell by ribose nucleic acid separated from tobacco mosaic virus.

protein alone. After the virus attaches, it disintegrates and the subunits are arranged at the surface. The subunit containing nucleic acid enters the cell, the others do not. This subunit goes into the nucleus and induces the production of more nucleo-protein like itself. These migrate into the cytoplasm in which new protein subunits are produced. The new virus materials are assembled into particles in extrusions of the cell wall. One cell may yield several hundred, even several thousand, new particles.

Unlike bacterial viruses, those of animals and plants do not uniformly destroy host cells on multiplication. Some animal viruses may reproduce in the same cells for days without seriously altering them. Influenza and mumps are viruses of this sort. Other animal viruses are more destructive and reproduction leads to severe damage or death of the cell in a few hours. Poliomyelitis and some of the encephalitis viruses are such agents.

Cell damage is the basis on which virus disease develops (17). It occurs only if the virus multiplies. To induce pathological changes the virus must reproduce and increase in numbers. The processes that cause cells to react to this development within them remains mysterious.

To manage viruses it may be necessary to learn to control their reproduction. On theoretical grounds this does not have the aspect of a simple problem. On experimental trial it proved to be a difficult problem; one that has not been solved in a useful manner. It is fairly easy to prevent a virus particle from attaching to a host cell. This is accomplished in several ways which are widely used as means for the prevention of virus infections. Vaccination procedures against small-

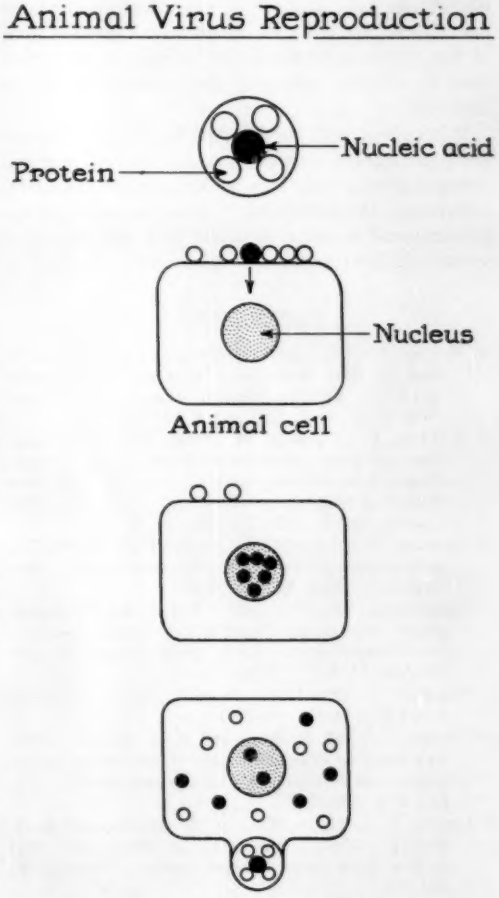

FIG. 6. Diagrammatic schema of reproduction of an animal virus. Based on studies of fowl plague virus (25).

pox, influenza, and poliomyelitis are typical examples (19).

To control the reproductive process once the nucleic acid has entered the cell is an entirely different undertaking. Innumerable attacks have been made on this problem through a variety of approaches. In addition to numerous empirical ventures which have not been rewarding there have been efforts to use modern biochemical knowledge. The yield has been small but it is not negligible (18). Six compounds of known chemical structure have been discovered which inhibit the reproductive process inside the cell. Some affect the metabolism of ribonucleic acid, others that of protein while others affect both. These are vital processes, as essential for the continuing life of the cell as for the reproduction of virus particles in the cell. As might be anticipated none of the compounds known to inhibit reproduction does so without affecting the metabolism of the host cell.

Whether it will be feasible to discover or develop substances that can manage viruses without damaging host cells is a question that cannot be answered. With high faith in the ingenuity of the human mind it seems doubtful that this objective is unattainable; it may only take longer to reach it.

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HYBRIDIZATION IN SOME COLOMBIAN TANAGERS, AVIAN GENUS *RAMPHOCELUS*

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(*Read April 25, 1958*)

INTRODUCTION

THE adaptation of an organism to its environment is accomplished through the interaction of natural selection and heritable variation. Heritable variants, resulting from genetic recombination and mutation, are selected by the environment in the classical Darwinian sense. The result is a constantly changing Mendelian gene pool the composition of which, at any given time, depends upon the available variants and the effects of selection upon them. As long as the individuals of such a population are able to interbreed freely the entire population will evolve together but if an extrinsic barrier should isolate one part from the remainder the free exchange of genes is stopped. Even though selection might be identical upon the two resulting populations they will diverge genetically from one another because mutation and recombination will, by chance alone, be different. Such isolated populations will gradually accumulate genetic differences leading to the establishment of intrinsic reproductive isolating mechanisms which will prevent interbreeding if the extrinsic barrier breaks down.

Because this process is gradual the possibility exists that the extrinsic barrier may fail before reproductive isolating mechanisms have had time to evolve but after well-marked morphological characters have developed. In such a case the result will be hybridization between two populations differing greatly in appearance but forming fertile, viable hybrids (Sibley, 1957).

The purpose of the present paper is to describe a situation involving an example of such a secondary contact resulting in hybridization.

NOMENCLATURAL HISTORY

The Neotropical tanager genus *Ramphocelus* contains some seven or eight species ranging from Mexico to southern Brazil. In *Ramphocelus flammigerus* of the Cauca Valley of western Colombia the males are black with a scarlet rump. The males of *Ramphocelus icteronotus*, which occurs in the coastal lowlands from Panama through western Colombia to Ecuador, are black with a bright yellow rump. Specimens with rumps of intermediate color (reddish-orange, orange, yellowish-orange) have been known from intermediate localities at least since 1853 when Lafresnaye described *Ramphocelus chrysonotus* from Los Cisneros, Colombia.

The significance of the "*chrysonotus*" type of plumage coloration has been debated at length. In 1917 Chapman expressed the opinion that the intermediate types probably resulted from hybridization between *flammigerus* and *icteronotus*. Griscom (1932) accepted Chapman's explanation and identified two additional "species" as hybrids between *flammigerus* and *icteronotus*. Hellmayr (1936) did not accept Chapman's point of view and felt "inclined to attribute the case to an excessive amount of individual variability" (p. 265) although he also noted (p. 268) that having seen no females of *chrysonotus* he felt that he was "not in a position to throw any new light on this much discussed problem."

De Schauensee (1951 : 1050) placed *chrysonotus* in the synonymy of *R. icteronotus* and expressed the firm opinion that *chrysonotus* "is undoubtedly a hybrid between *R. icteronotus* and *R. flammigerus*."

THE PRESENT STUDY

During June, 1956, the writer collected 97 specimens from several localities between Cali, in the Cauca Valley, and Buenaventura, on the Pacific Coast west of Cali.[1] Map 1 indicates the geo-

[1] The trip to South America, during which the field study was conducted, was supported by a grant from the Penrose Fund of the American Philosophical Society; by funds available under National Science Foundation grant no. G-1842, by a grant from the Faculty Research Fund of Cornell University, and by the New York State College of Agriculture at Cornell University.

In Colombia the generous help which I received from Dr. F. Carlos Lehmann is gratefully acknowledged. Sr. Jorge Durán assisted with the collection and preparation of specimens. Dr. José I. Borrero kindly helped with the

graphical situations and the localities to be discussed.

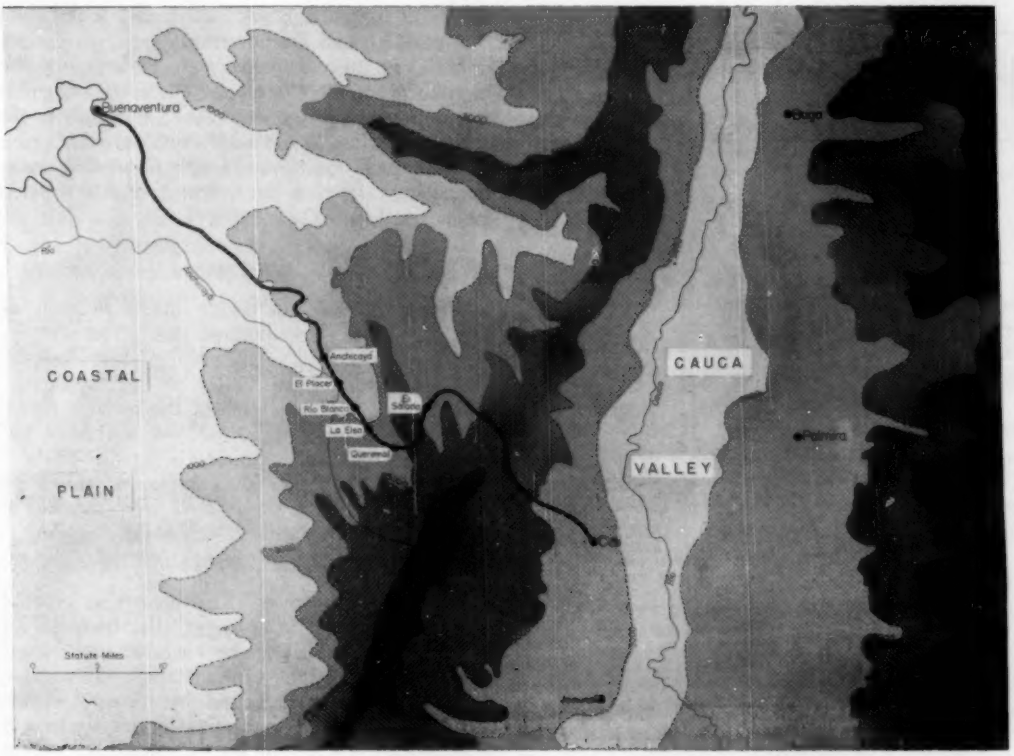
In the Cauca Valley at 3,200 feet elevation and on the eastern slope of the Western Andes the adult males are typical *flammigerus* with bright scarlet rumps. Birds from the western slope of the range form a gradient in rump color from scarlet at 6,000 feet elevation, through various shades of orange, to the bright yellow of typical adult male *icteronotus* on the coastal plain below 1,000 feet. The histograms of figure 1 indicate the color types at each of eight main localities from Cali to Buenaventura, a distance of 140 kilometers by road and approximately 80 kilometers (50 miles) in an air line.

At El Salado, 4,300 feet, and 43 kilometers by road from Cali, the rump color of adult males ranges from reddish-orange to orange. The birds from Queremal, 4,800 feet, and 49 kilometers from Cali, are also mainly orange-rumped. At La Elsa, 3,300 feet and 62 kilometers from Cali, birds with orange-red and yellowish-orange rumps occur. This locality is six miles by road from Queremal. Five miles beyond La Elsa, at Río Blanco (2,000 feet; 72 kilometers from Cali), birds with nearly pure yellow rumps as well as one with an orange-yellow rump were found. In a series of 18 specimens from El Placer, 1,300 feet elevation and 75 kilometers from Cali, the rump color is yellow and yellowish-orange in most of the birds. One specimen in this series has an orange rump.

At Anchicayá, 1,000 feet elevation and 100 kilometers from Cali, the three adult males collected, and most of those seen but not taken, had bright yellow rumps. Two birds with orange-yellow rumps were seen but could not be collected. In an immature male in juvenal plumage the rump and breast are orange-yellow.

problem of collecting permits and the importation of collecting supplies.

A week's stay at Anchicayá was made possible by the hospitality of M. and Mme Philippe Lechat. Frances Sibley prepared the illustrations.



MAP 1. Localities in western Colombia mentioned in the text.

From Anchicayá to Buenaventura all adult males collected (7), and many more seen, had the bright yellow rumps of typical *icteronotus*.

The coloration of the adult females follows a parallel cline but is less striking because the extremes of color are not as great. Cauca Valley birds (typical *flammigerus*) have dark brown backs, wings, and tails. The coverts and feathers of the back are tipped with buff or yellowish buff. The rump is reddish-orange and the underparts are mainly dull yellowish or orange yellow with a brighter reddish-orange band across the breast. Females from the coastal plain (=*typical icteronotus*) differ only in the color of the rump and underparts. Both of these areas are yellow and there is but a faint indication of the breast band in the slightly deeper color tone of this area.

Between Cali and Buenaventura the cline in color of the females is as follows. At El Salado and Queremal the coloration of ten specimens ranges from orange through yellowish-orange to two which are nearly as yellow as typical *icteronotus*. Nine specimens from La Elsa range in color from orange (2) through yellowish-orange (1) to dull yellow and yellow (6). Five from Rio Blanco vary from yellowish-orange (1) to dull yellow (3) to yellow (1). Four from El Placer are dull yellow or yellow. The single female from Anchicayá is dull yellow. Below Anchicayá the three specimens and many others seen are seemingly pure *icteronotus*. The histograms of figure 1 indicate the female color cline between Cali and Buenaventura.

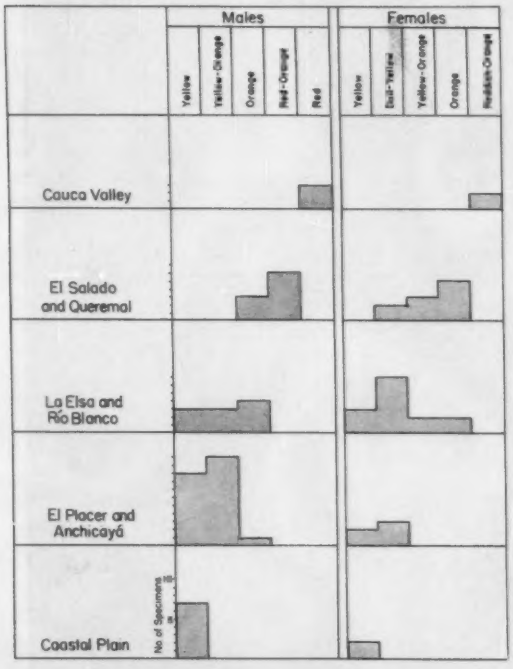


FIG. 1. Histograms of color types in population samples of *Ramphocelus* from certain localities in western Colombia.

TABLE 1

AVERAGE WEIGHT IN GRAMS OF *Ramphocelus* TANAGERS FROM CERTAIN LOCALITIES IN COLOMBIA

Locality	Males		Females	
	No. of specimens	Average wt.	No. of specimens	Average wt.
Cauca Valley	2	45.1	1	38.0
El Salado and Queremal	9	43.5	10	38.9
La Elsa and Río Blanco	10	41.8	14	39.0
El Placer and Anchicayá	21	40.0	5	38.6
Coastal Plain	8	40.0	3	35.1

Males in juvenal plumage are indistinguishable in color from adult females. Although only nine sexed juvenile males were taken they follow the same color cline as the adult females. The single juvenile male from Anchicayá previously mentioned indicates that the influence of *flammigerus* extends at least to that point.

WEIGHT

Weight is the best single index to size, as Amadon (1943) has pointed out. The weights of the males show a small, gradual shift from the heaviest in the Cauca Valley to lightest on the coastal plain. The weights of the females reveal little or no definite trend and the difference between the terminal localities is small. Table 1 indicates the average weights of a series of samples.

DISCUSSION

From the evidence of clinal change in coloration and weight it is apparent that there is no genetic barrier between the birds of the coastal plain and those of the Cauca Valley. Introgression is clearly in progress and there is no evidence that the intermediate populations are at a selective disadvantage.

The history of this situation and the factors which have led to it are not difficult to reconstruct.

Before the advent of agriculture in western Colombia suitable habitat for these birds existed only in the Cauca Valley and along the coastal plain. In between, on the slopes of the Western Andes, there was a dense rain forest of virgin jungle which was a barrier to these birds of scrub and second-growth vegetation. As agriculture developed, the jungle was cleared and plantations of bananas and coffee spread over the flanks of the Andes, especially along the river valleys, creating ideal habitat for the tanagers. Both types extended their ranges into this newly available environment and eventually came into secondary contact. Because intrinsic isolating mechanisms had not evolved during their geographic isolation they have interbred freely and the hybrid gradient has resulted. Gene migration from the large, relatively stable, gene pools at each end of the gradient maintains the high variability due to recombinations of *flammigerus* and *icteronotus* characters.

The ultimate fate of these populations can be predicted, assuming that the extrinsic barrier will not become re-established. As the interface between red and yellow types increases in extent, introgression will increase until the entire population of the Cauca Valley becomes affected by gene migration from the lowlands. The coastal population, being much larger, will be less rapidly affected. Gradually selection will fashion a new adaptive peak from the rejoined populations and the present variability will decrease.

The taxonomic status of *flammigerus* and *icteronotus* should be re-examined. There being no evidence of selection against the hybrids and ample evidence, judging from their abundance, that they are fully fertile and ecologically successful, it seems appropriate to consider them subspecies of one species. The name *flammigerus* of Jardine and Selby (1833) has priority as the specific name over *icteronotus* of Bonaparte (1838).

Similar patterns of hybridization are known from several other parts of the world, most of them also resulting from human land-use activities. In the red-eyed towhees (*Pipilo*) of Mexico ecological barriers between two closely related, but morphologically very different, species have been broken down by the cutting of forests. Hybridization over a vast area has resulted and some seven hybrid gradients, similar to the one described in *Ramphocelus*, are now known (Sibley, 1950; 1954; Sibley and West, 1958).

The disturbance of ecological barriers by man has also apparently been the factor which has permitted hybridization to occur between the two North American toads, *Bufo woodhousei* and *Bufo americanus* (A. P. Blair, 1941; W. F. Blair, 1958).

The planting of trees across the Great Plains of North America has permitted several species of woodland birds to extend their ranges. In several instances closely related species, previously isolated by the grassland barrier, have come into secondary contact and have hybridized. These include the Baltimore and Bullock's orioles (*Icterus*), rose-breasted and black-headed grosbeaks (*Pheucticus*), indigo and lazuli buntings (*Passerina*), and the yellow-shafted and red-shafted flickers (*Colaptes*).

In the flickers an important color difference involves red and yellow pigments as in the *Ramphocelus* tanagers. Hybrid flickers are intermediate in coloration. Test (1942) has shown that the colors are due to carotenoid pigments of three main types. Two of these occur in one parental type (*auratus*) while all three are found in the other parent (*cafer*) and in the hybrids. The striking differences in color result from the varying amounts of the three pigment types present, not from qualitative differences. Dickinson (1953) has recently expressed the opinion that the two flickers are conspecific, and studies in progress by Lester Short and the writer amply support this point of view.

In the Northwest Frontier Province of Pakistan two bulbuls (*Pycnonotus*) hybridize. These differ in several characters including the color of the crissum which is yellow in one (*leucogenys*) and red in the other (*cafer*). Again the hybrids are various shades of orange in this plumage area (Sibley and Short, 1958). Other close relatives of *P. cafer* also have the crissum yellow.

If, as seems probable, the yellow, orange, and red pigments in the tanagers and bulbuls are chemically similar to those in the flickers it seems logical to assume that the genetic change required to shift from red to yellow is relatively small. Taxonomic judgments based upon these colors should take this into account.

Further evidence that the differences in color in *Ramphocelus* are due merely to the relative amounts of pigments present comes from other sources. In captive birds the rump color will

change. On June 8, 1956, a captive adult male *R. flammigerus* was examined at a roadside house five miles east of Cali. The rump was orange although the owner assured me that it had been captured in the vicinity where the wild males have bright scarlet rumps. Both Dr. F. Carlos Lehmann of the University of Valle in Cali and Mr. William G. Conway of the New York Zoological Society have told me that this color change in captivity is well known to them.

It seems quite certain that this type of change in captive individuals results from nutritional deficiencies. It is well known that animals cannot synthesize carotenoid pigments themselves but must depend for their supplies of these pigments upon ingested plant materials (Test, 1942). In captive male House Finches (*Carpodacus mexicanus*) the red areas of plumage will come in yellow after a molt unless carotenoids are added to the diet during the period before and during feather growth. The same situation is found in flamingos (*Phoenicopterus*) in captivity.

Color also changes with the age of the individual as is clearly seen in the series of immature males previously described as being similar to the females and thus lighter in color than adult males. In Cauca Valley birds the immature males have reddish-orange rumps which change to scarlet red after the first post-nuptial molt. Plath (1945) records this sequence in an immature male *Ramphocelus* with a light orange-yellow rump which was received at the Chicago Zoological Park in December, 1941. After a few months this bird molted and acquired a rump of scarlet color which persisted.

These facts might seem to suggest the possibility that the entire range of variation in color is due to differences in age and nutrition. That there is also a genetic basis for the color is shown by the occurrence of adults with variously-colored rumps at a single locality in the wild and by the fact that color change in captivity goes only from red to orange, never from yellow to orange. The genetic mechanism thus controls the upper limit of carotenoid deposition while the lack of available carotenoids simply results in color dilution.

SUMMARY

In Colombia there occur two closely related tanagers of the genus *Ramphocelus* which are alike in voice, behavior, and habitat selection. They are abundant in areas of second-growth vegetation, banana plantations, and natural scrubby vegetation, but absent from the dense rain forest.

Ramphocelus flammigerus, in which the males are black with a scarlet rump, occurs in the Cauca Valley of western Colombia and in adjacent areas above approximately 3,000 feet elevation. *Ramphocelus icteronotus*, in which the males are black with a bright yellow rump, occurs along the coastal plain from Panama to Ecuador. Females and immatures are similar to their respective males but less strongly colored. Hybrids between these two forms occur in geographically intermediate areas and show intermediate coloration in having rumps of reddish-orange, orange, yellowish-orange, etc. A gradient in weight also is present, the Cauca Valley population being the heavier and coastal birds being the lighter.

Present evidence indicates that the cutting of the virgin forest from the western slopes of the Western Andes permitted the two types to come into secondary contact after a period of isolation during which the observed differences evolved. The hybrid populations provide a pathway for gene migration between the parental populations, gene exchange appears to be unimpeded, and there is no evidence of selection against the hybrids.

The two forms are considered to be subspecies of a single species. This point of view is in accordance with the evidence from the field study and that derived from comparison with similar situations in other parts of the world.

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RECONSTRUCTING THE ANCESTOR OF CORN

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(*Read April 25, 1958*)

OUR purpose in reconstructing the ancestor of corn is to retrace, so far as possible, some of the principal steps which have been involved in its evolution under domestication. We do this in the hope of gaining a better understanding of the corn plant as one of those unique biological systems which man employs on a grand scale to convert the energy of the sun, the carbon dioxide of the air, and the minerals of the soil into food. Corn is one of perhaps not more than a dozen species of cultivated plants of world-wide importance—each one the principal source of food of millions of people—which quite literally stand between mankind and starvation.

But corn is something more than an important food plant; it is also a mystery, a fascinating botanical mystery, as challenging to a scientist as is a mountain to an explorer.

Modern corn, our starting point in this study, is unique among the cereal grasses in the nature of its inflorescences (2, 4, 12). The terminal inflorescence, commonly called the "tassel" (fig. 1A, C), usually bears only male flowers each of which contains three pollen sacs or anthers (fig. 1D) packed tightly with some 2,500 pollen grains. These are small, about 1/250 inch in diameter, light in weight, and are easily carried by the wind. Thus corn, in contrast to the majority of cereals, is a naturally cross-pollinated plant. It is this feature which makes possible the production of hybrid corn, one of the most spectacular developments in applied biology of this century.

The lateral inflorescences (fig. 1A, B), which when mature become the familiar ears of corn, have only female flowers which bear the pollen-receptive organs commonly known as the "silks." These are covered with fine hairs and are admirably designed to capture wind-blown pollen (fig. 1E). Each silk represents a potential kernel and must be pollinated in order for that kernel to develop. The kernels themselves are firmly attached to a rigid axis, the cob, and are not covered as are those of other cereals by the floral bracts which botanists call "glumes" and which the layman knows as "chaff." Instead the entire ear is enclosed, often quite tightly, by modified leaf sheaths, the husks or shucks (fig. 1B). Thus, while in other cereals the kernels are protected individually, in corn they are covered *en masse*. The result is that cultivated corn has no mechanism for the dispersal of its seeds and hence is no longer capable of reproducing itself without man's intervention. The very characteristics which make corn so useful to man render it incapable of existing in nature and it is probable that corn would quickly become extinct if deprived of man's protection.

How, then, did corn's wild ancestor differ from cultivated corn in ways which enabled it to exist in nature for thousands, if not millions, of years

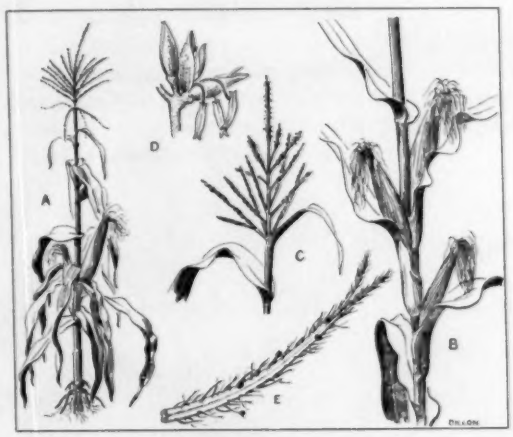

FIG. 1. Botanical characteristics of the modern corn plant. A. The entire plant showing the male inflorescence, the tassel, at the tip of the stalk and the female inflorescences, the ears, in the middle region. B. Young ears enclosed in husks with the pollen-receptive organs, the silks, protruding from the ends. C. Typical tassel. D. Typical male flower with three anthers containing pollen. E. A single silk magnified to show hairs and adhering pollen grains. From Mangelsdorf (4) by permission of *Encyclopaedia Britannica*.

before man appeared on the scene? This is one of the questions which we hoped to answer by reconstructing the ancestral form. Our reconstruction is based in part upon fossil and archaeological remains and in part upon genetic recombination of some of the primitive characteristics which still exist in modern corn varieties.

The fossil evidence comprises a number of pollen grains isolated from a drill core taken from a depth of more than 200 feet below the present site of Mexico City. These were recognized as unusually large pollen grains of a grass by Dr. Paul Sears of Yale University and Mrs. Kathryn Clisby of Oberlin College who, in connection with charting climatic changes, were engaged in pollen studies of the drill core. The pollen was identified by Dr. Elso Barghoorn (1) of Harvard University as that of corn which has the largest pollen of any known grass. Although assigned to the last interglacial period and therefore, on the basis of recent estimates, probably at least 80,000 years old, the fossil pollen is scarcely distinguishable in size, shape, and other characteristics from modern corn pollen (fig. 2). This fact leaves little doubt that the ancestor of corn was corn and not one of its two American relatives, teosinte or *Tripsacum*.

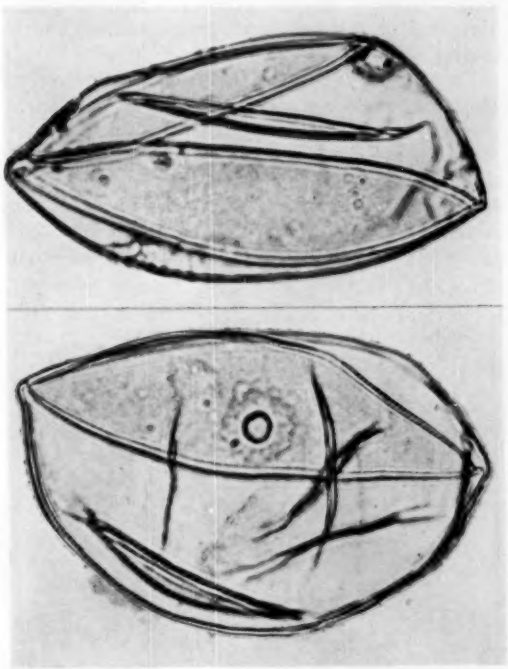

FIG. 2. Fossil pollen of corn (upper) from more than 200 feet below the present site of Mexico City compared with a pollen grain of modern corn (lower) at the same magnification. In spite of some 80,000 years difference in their age these two pollen grains are virtually identical in their characteristics and they show that the ancestor of corn was corn and not one of its two American relatives, teosinte or *Tripsacum*. From Barghoorn *et al.* (1). × 570

FIG. 3. Three cobs of prehistoric corn from Bat Cave compared with a one-cent piece. Radiocarbon determinations of associated charcoal date these at 5,600 years. Natural size.

The oldest known remains of cultivated corn come from a once-inhabited rock shelter in New Mexico known as Bat Cave which was excavated by Mr. Herbert Dick, of the Peabody Museum of Harvard University and later of the Colorado University Museum, in two expeditions in 1948 and 1950 (5, 9). This cave was inhabited for several thousand years by people who practiced a primitive form of agriculture and an even more primitive pattern of sanitation. During the centuries of their occupancy, garbage, excrement, and other debris accumulated in the cave to a depth of six feet creating exactly the kind of site which archaeologists delight to dig into. At the bottom of this accumulation of trash, Mr. Dick turned up some tiny cobs of ancient corn which have been dated, on the basis of Dr. Willard Libby's radiocarbon determinations of associated charcoal, at about 5,600 years.

Three of these ancient cobs are compared in figure 3 with a one-cent piece whose diameter is about equal to their length. One of the tiny specimens is compared in figure 4 with ears of two modern races of corn: the dent corn of the U. S. Cornbelt and a large-seeded flour corn of Peru. How could a corn like the Bat Cave corn have evolved into these and other modern races even in 5,600 years? This is the principal question

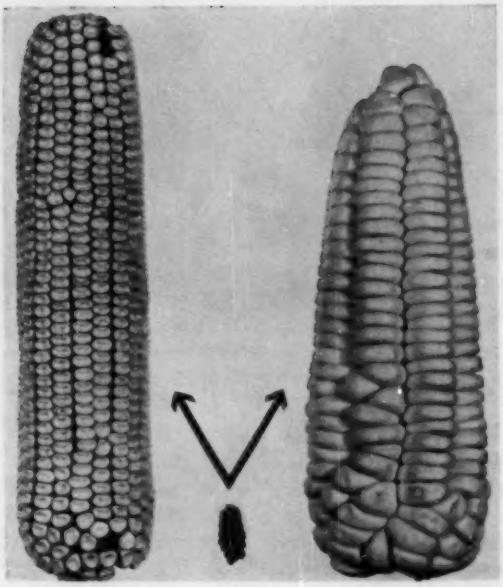

FIG. 4. One of the Bat Cave cobs compared to a modern ear of Cornbelt dent (left) and a large seeded Peruvian flour corn (right). Extremely rapid evolution has been involved in producing such drastic changes even in 5,600 years, the estimated difference in their age.

which we hoped to answer by retracing some of the steps involved in corn's evolution under domestication.

Since there were no living seeds of the Bat Cave corn it was impossible to work forward experimentally from it to modern corn. The alternative was to work backward from present-day corn by combining primitive characteristics still occurring in living varieties. But what characteristics of corn are primitive? My associate, Dr. Galinat, and I sought to determine this by an intensive study of one of the Bat Cave specimens which contained the partial remains of a single kernel. Each part of this cob was carefully dissected out and measured. On the basis of the measurements, Dr. Galinat prepared the diagrammatical, longitudinal section illustrated in figure 5. The tiny kernels which this cob must once have borne could only be those of popcorn, a type in which the kernels are small and hard and capable of exploding when exposed to heat. The long stems or pedicels on which the kernels were borne and the long floral bracts which almost completely enclosed them show that the Bat Cave corn was also a form of pod corn, a type in which the individual kernels are enclosed in pods or chaff.

It is interesting to note in this connection that the late Dr. E. Lewis Sturtevant, a long-time student of corn, concluded many years ago that both popcorn and pod corn are primitive. My former colleague, Dr. Reeves, and I (8) later reached a similar conclusion. The ancient Bat Cave specimens provide convincing archaeological evidence in support of these conclusions.

What we have done, then, is to cross a number of varieties of popcorn from various parts of the world with pod corn (fig. 6) which still occurs as a "rogue" or "freak" in some South American varieties and which in some localities is preserved by the Indians who believe it to have magical properties. Pod corn has also sometimes been grown in gardens in the United States as a curiosity. Today it is most likely to be found in the experimental cultures of corn geneticists who maintain it as one of the "marker" genes on the fourth longest chromosome of corn.

There is no doubt that pod corn is primitive in its characteristic of enclosing the kernel in glumes or chaff as do all other cereals and virtually all other grasses. Despite this fact and because it is often monstrous and sometimes sterile, it has been dismissed by a number of botanists from any role in the ancestry of corn (11, 13). We believe that its monstrousness has been misunderstood—that

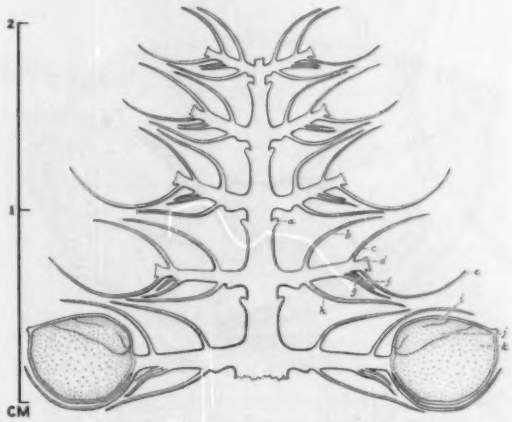

FIG. 5. Diagrammatic longitudinal section of one of the Bat Cave cobs based on measurements of dissected parts. The tiny kernels show that this was a popcorn; the long pedicels on which the kernels are borne and the bracts which almost enclose them indicate that it was also a pod corn. Drawing by W. C. Galinat.

pod corn is monstrous today only because it is a "wild" relict character superimposed upon modern highly domesticated varieties. Today's pod corn is comparable to a 1900 chassis powered by the engine of a 1958 car. The surprising thing is not that pod corn is sometimes monstrous but that it is not more so—that the particular genic locus which governs its expression is capable of functioning at all in a milieu so different from that in which it evolved and to which it was undoubtedly well adapted. We have assumed that pod corn would be less monstrous and would exhibit normal grass characteristics when combined with other "wild" genes and we hoped to find these in varieties of popcorn.

Our hopes have been realized. Popcorns in general tend to reduce the monstrosity of pod corn when crossed with it and some varieties do so quite drastically. The varieties Lady Finger and Argentine carry complexes of modifying genes which appreciably reduce the monstrosity of pod corn and a third variety, Baby Golden, carries a major modifying gene which, on the basis of preliminary linkage tests, appears to be on the sixth chromosome and which acts as an inhibitor of pod corn reducing its expression by approximately half.

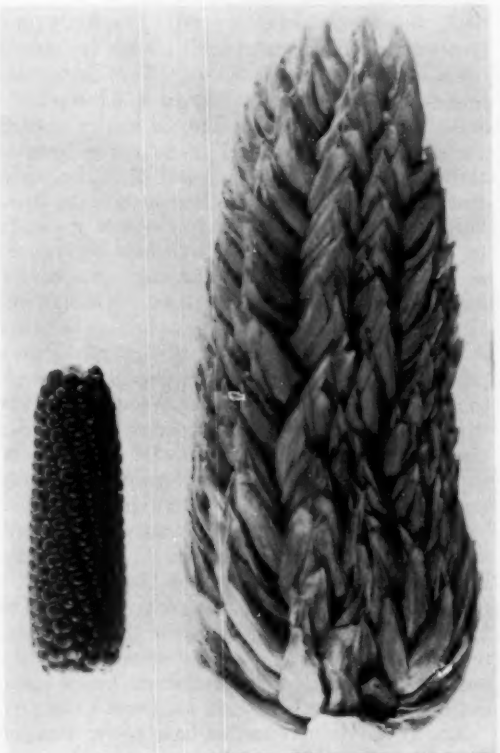

FIG. 6. An ear of Argentine popcorn (left) and of present-day pod corn (right). Popcorn is primitive in having small hard seeds. Pod corn is primitive in having its seeds enclosed in pods or chaff as do the other cereals. These two types were crossed in order to combine their primitive characteristics.

FIG. 7. Three plants of a many-stalked popcorn differing with respect to the pod corn gene. The first plant (left) lacks this gene; the second (center) has it on one member of the fourth chromosome pair; and the third (right) has the gene on both members of the fourth chromosome pair. The progressive decrease in height is associated with the pod corn gene which causes, among other effects, a shortening of the internodes of the upper part of the stalk.

By combining these modifying and inhibiting genes from several popcorn varieties with the pod corn gene, we have developed a number of strains of popcorn which, having this gene present on both of their fourth chromosomes, breed true for the pod corn character. Some of these homozygous strains are much less monstrous than the usual forms of pod corn, are completely fertile, and might under suitable conditions be capable of surviving in the wild.

The majority of these true-breeding pod-popcorns have other characteristics which we may now regard as primitive. The plants, when grown on fertile soils, instead of having one stalk as do most modern corns, have several (fig. 7) and in this respect resemble the majority of wild grasses including all of the known relatives of corn, both American and Asiatic. The plants are shorter than ordinary corn because one of the numerous effects of the pod corn gene is to shorten and thicken the upper internodes of the stalk. This is well il-

FIG. 8. A tassel and ear of a true-breeding pod corn. The shortening of the internodes of the upper part of the stalk causes or is accompanied by a tassel which bears both male and female flowers. The withered silks immediately below the tassel are from female flowers on the tassel branches which bloomed several weeks before this photograph was taken. Several seeds, resulting from pollination of these flowers, are visible. Such seeds are easily dispersed when mature by the breaking of the fragile tassel branches. The fresh silks to the left of the tassel are from a subtassel ear which is enclosed in husks when young but can emerge from them and disperse its seeds when mature. The silks of this ear can be pollinated by pollen from the anthers in the tassel of the same plant but the female flowers in the tassel can receive pollen only from another plant. Thus, the reconstructed primitive corn plant has devices for both self- and cross-pollination.

lustrated in figure 7 which shows three plants of popcorn in one family: one lacking the pod corn gene, one having the gene on one member of its fourth chromosome pair, and one having the gene on both members of the pair. There is a progressive decrease in height through this series of three genotypes resulting from a shortening of the upper internodes. This shortening causes, or at least is accompanied by, the development of a terminal inflorescence which bears both male and female flowers, the male flowers at the tips and the female flowers at the bases of the same tassel branches (fig. 8). These branches are quite brittle when mature and break apart easily when disturbed by the wind or by birds. They thus provide one of the most important primitive characteristics which cultivated corn lacks: a mechanism for the dispersal of seeds.

Plants of homozygous pod corn frequently do not have ears—most of their energy is apparently concentrated in the terminal inflorescences—but when they do have ears these are usually borne high upon the stalk (fig. 8), often at the joint of the stem immediately below the tassel. This elevation of the position of the ear has profound effects which are illustrated by the diagram in figure 9. The diagram, which is based on data from several many-eared plants, shows how a number of the characteristics of the ears are determined by their position on the stalk: (1) The higher the position, the smaller the ear, partly for the simple mechanical reason that the stalk at this position is slender and is incapable of bearing a heavy load. It would be mechanically impossible for the large modern ear of corn to be borne near the slender tip of the stalk. (2) The higher the position, the more likely is the ear to have both male and female flowers. (3) The higher the position, the shorter the lateral branch or "shank" upon which the ear is borne. The shorter the branch, the fewer the joints from which the husks arise, the fewer the husks and the less completely the ear is enclosed. Thus an ear borne immediately below the tassel is enclosed while the young seeds are developing but as these mature the husks flare open allowing the ear to disperse its seeds. In short, a simple change in position determined by a single gene change can provide a mechanism for dispersal of the seeds borne on the ear as well as those borne on the fragile branches of the tassel.

These facts seem to answer several of the most puzzling questions involved in previous attempts to explain corn's evolution: How could wild corn have survived the handicap of an ear incapable of dispersing its seeds? And if wild corn had no ears, how could the ear of modern corn, its most important organ, have come into existence?

The position of the ear has an effect on still another characteristic illustrated in figure 9, the length of the streamers or leaf blades which in many varieties terminate the outer husks. The higher the ear the more likely are the leaf blades to be short or absent. This may explain the absence of leaf blades in prehistoric husks found both in Bat Cave (9) and in La Perra Cave (6).

The most primitive ear we have so far obtained by combining popcorn and pod corn is shown in figure 10 in comparison with an ear of modern dent corn and with the most primitive cob, dated at 4445 ± 180 years, from La Perra Cave which was excavated by Dr. Richard MacNeish of the National Museum of Canada.

FIG. 9. Diagrammatic longitudinal section based on data from several plants of a many-eared corn stalk showing how the position of the ear on the stalk affects its characteristics. The higher the ear, the smaller its size, the fewer its husks, and the more likely it is to bear both male and female flowers. Drawing by W. C. Galinat.

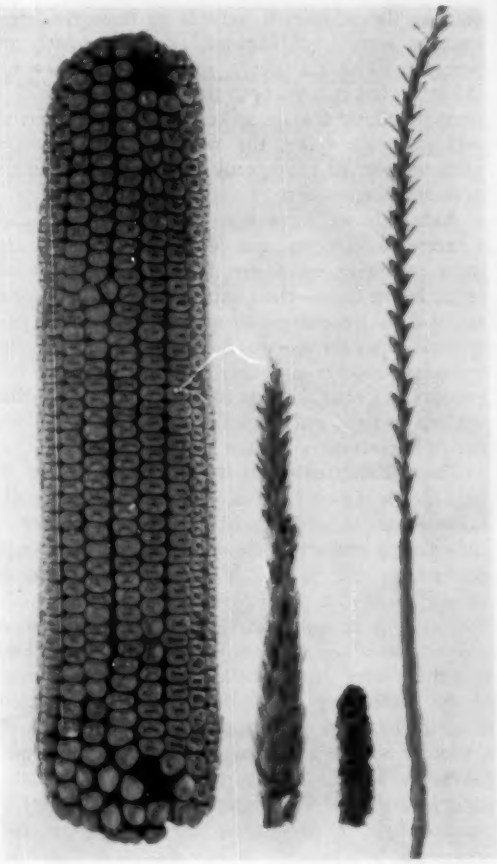

FIG. 10. The reconstructed ancestor of corn, an ear of pod-popcorn (B), compared with a modern ear of dent corn (A) and a prehistoric cob of La Perra Cave corn (C). The dent corn weighs 317 grams, the reconstructed ear 1.99 grams. The reconstructed ear has female flowers below and male flowers above and in this respect resembles a spike of *Tripsacum* (D), a wild relative of corn. The La Perra cob (C) also once had a male portion which has been lost; only the stump of its stem still remains. Without its kernels and male spike, the reconstructed ear would weigh .87 gram; only slightly more than the La Perra cob which weighs .52 gram.

In weight and number of kernels our reconstruction is much closer to the prehistoric La Perra specimen than to the ear of modern dent corn. The modern ear weighs 317 grams. The ear of pod-popcorn weighs 1.99 grams. However, only 24 of its 38 female flowers developed kernels. Had all done so, it would weigh 2.47 grams, as-

suming the additional kernels to have the same average weight, .034 gram, as those which are present. The La Perra specimen weighs only .52 gram but it lacks both the 48 kernels, which it once bore, and a male spike. Without its kernels and its male spike, the reconstructed ancestral form weighs .87 gram, only slightly more than the prehistoric specimen.

Although we have not yet completely reconstructed wild corn, nor duplicated exactly the most primitive specimens from either Bat Cave or La Perra Cave—the glumes of the pod-popcorns are still too prominent to match those of the prehistoric specimens—we have succeeded in developing what is probably the world's most unproductive corn. This is useful in suggesting that we are on the right track in attempting to retrace corn's evolutionary paths.

The reconstructed ear illustrated in figure 10 has female flowers on its lower half and male flowers on the remainder. This, as figure 9 shows, is a characteristic of ears borne in a high position on the stalk. If our reconstruction is valid, should not prehistoric ears also bear male flowers? A reexamination under the microscope shows that at least some of them once did and that these have since been lost in handling. Some of the ancient cobs, including the one illustrated in figure 10, have stumps, previously unnoticed, of a slender stem on which male flowers were undoubtedly borne. Thus, our genetically reconstructed ancestral form has taught us to look for a characteristic in prehistoric ears which we had previously overlooked. It has also shown us the significance of ears bearing terminal male spikes which are still found in certain races of corn in the countries of Latin America: the races Nal-Tel and Chapalote of Mexico (14), Pollo of Colombia (10), and Confite of Peru. Finally it may explain some curious ears, which had previously puzzled us, moulded in bas relief on a prehistoric Zapotec funerary urn from Mexico. The urn is shown in figure 11, and the details of one of the ears in figure 12.

In bearing both male and female flowers these ears of pod-popcorn also resemble the lateral inflorescences of *Tripsacum*, a perennial grass and a wild relative of corn (fig. 10). This resemblance has in turn called attention to additional characteristics in which this reconstructed corn resembles *Tripsacum:* (1) flowering of the female spikelets before the male in both lateral and terminal inflorescences; (2) the many-stalked condition; (3) the small, hard, pointed seeds.

FIG. 11. A prehistoric Zapotec funerary urn from Mexico with two representations of primitive corn ears in the headdress and one in the hands of the maize god.

FIG. 12. Details of one of the ears shown in figure 11. It is probable that the slender column above the small ear was intended to represent the male spike of a prehistoric ear similar in some of its characteristics to the reconstructed ancestral form illustrated in figure 10.

Actually this reconstructed corn might easily be classified as an annual form of *Tripsacum* or conversely, since corn was the first of the two to be given a Latin name, *Tripsacum* could be clas-

sified as a perennial form of the genus, *Zea*, to which corn belongs and which, until recently, has been represented by the single species, *Zea mays*.

These unexpected results of combining popcorn and pod corn—the production of a counterpart of corn's wild relative, *Tripsacum*—we regard as additional evidence that our reconstruction has validity.

Figure 13 illustrates some of the principal environmentally induced and genetically controlled changes which are believed to have occurred during domestication. The first three plants illustrate the genetically reconstructed ancestral form as it would be expected to develop in three different environments. The first plant, a short, single-stalked plant with a slender, unbranched tassel bearing both male and female flowers and no ears, is intended to represent the wild corn plant growing in nature in a site of low fertility and in severe competition with other natural vegetation. Such a plant would barely reproduce itself.

The second plant represents this same genotype grown under primitive agricultural conditions. Here it is still single stalked, but under these some-

FIG. 13. Environmentally induced and genetically controlled variation in the corn plant. *Left:* a plant of pod-popcorn as it might have grown in nature in a poor site in competition with other natural vegetation. *Second:* the same grown under primitive agricultural conditions. *Third:* the same in a fertile site free of competition with weeds. This plant is essentially the same as the third plant in figure 7. *Fourth:* a popcorn plant which has lost the pod corn gene. This is the counterpart of the first plant in figure 7. *Fifth:* human selection for larger ears has tended to eliminate the secondary stalks reducing them to "suckers" as in this typical plant of a New England flint corn. *Right:* this trend has been carried still further in Cornbelt dent corn which is usually single stalked, commonly bearing a single large ear in the middle region of the stalk. The middle position of the ear has both mechanical and physiological advantages over a terminal position and probably accounts for corn's superiority over other cereals in its capacity to produce grain. Drawing by W. C. Galinat.

what better conditions is capable of producing a branched tassel and a single small ear borne high upon the stalk. The third plant (a counterpart of the third plant in figure 7) represents the genetically reconstructed ancestral form grown under modern agricultural conditions with an abundance of fertilizer and in freedom from competition with weeds. Under these conditions it has several stalks as well as several small ears on each stalk. Plants like these might also have occurred sporadically in the wild under unusually favorable natural conditions.

The ability of the wild corn plant to respond in a spectacular fashion to freedom from competition with weeds and to high levels of fertility is undoubtedly one factor which led to its domestication. This ability to take full advantage of the improved environment usually afforded by an agricultural system is one of the characteristics found in almost all highly successful domesticated species. There are many wild species which do not have this trait; they cannot stand prosperity.

Since the corn plant is genetically plastic as well as responsive to an improved environment, domestication may soon have brought other changes which are illustrated in the last four plants in figure 13. One of the most important of these was a mutation at the pod corn locus on the fourth chromosome. This single genetic change had numerous effects. It reduced the glumes which in wild corn completely surrounded the kernels and the energy released from chaff production now went into the development of a larger cob which in turn bore more and larger kernels. The mutation also lowered the position of the lateral inflorescences and this had profound effects of several kinds which can be understood by referring again to figure 9. This shows that: (1) The lower the ear the stronger the stalk at the position at which the ear is borne and the greater its capacity for supporting large ears. (2) The lower the ear the more likely it is to bear only female flowers which develop kernels when pollinated. (3) The lower the ear the longer the shank, the branch on which it is borne, and this in turn has a number of important secondary effects: The longer the shank, the more numerous its nodes or joints and the husks which arise from them. The greater the number of husks, the more completely the ear is enclosed and the less capable it is of dispersing its seeds.

In short, a rather simple change but a very important one: the lowering of the position of the ear (comparable, perhaps, to moving the engine of a primitive airplane from a position behind the wings to one in front of them) has separated the sexes, made for a larger, strictly grain-bearing ear which is completely protected by the husks and is no longer capable of dispersing its seeds. In short, a mutation at a single locus on chromosome 4 has made the corn plant less able to survive in nature but much more useful to man.

The last two plants in figure 13 show some of the changes which human selection has subsequently effected. Selection for large ears has tended to eliminate the secondary stalks and to reduce the number of ears per stalk. The fifth plant in figure 13 represents a typical New England flint corn in which the secondary stalks have been reduced to low tillers known to the farmer as "suckers" which in days of cheaper labor were often removed under the erroneous impression that their removal was a kind of beneficial pruning operation. The last plant represents a typical Cornbelt dent corn which is predominantly single stalked and often bears only one large ear in approximately the middle region of the stalk.

The corn plant has a distinct advantage over other cereals in bearing its ears in the middle region of the stalk which, being thicker and stronger than the tip, is capable of supporting a larger ear. This is a simple and obvious mechanical advantage. There may also be a less obvious but even more important physiological advantage. We have evidence, to be reported elsewhere, that, under otherwise constant conditions with respect to the genotype and the environment, a decrease in the weight of the tassels may be accompanied by an increase five times as great in the weight of the ears. There is at least little doubt that corn, by virtue of its botanical characteristics, is potentially more productive than the other cereals. For example: record yields of wheat seldom exceed 100 bushels per acre; the maximum yields of corn recently reported are more than 300 bushels per acre.

There have, of course, been other factors, not discussed here, in corn's evolution under domestication: mutations at many loci in addition to that governing the characteristics of pod corn; extensive hybridization among distinct races (10, 14); repeated hybridization with teosinte (3, 6, 7) and perhaps also with *Tripsacum* (8); and human selection for many different characteristics. But it was this one mutation at the pod-corn locus —this single change in a molecule of the hereditary material—which more than any other factor has determined the botanical characteristics of modern

corn and which set the plant upon new evolutionary paths that have made it more useful to man and more dependent upon him for survival.

ACKNOWLEDGMENTS

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THE INFLUENCE OF SIGISMUND THALBERG ON AMERICAN MUSICAL TASTE, 1830–1872

VERA MIKOL

(*Read April 25, 1958*)

ONE of the happier consequences of this age of radio, television, and high-fidelity record-players has been the creation of a vast new audience for good music in America. In less than four decades since our earliest, frankly experimental, broadcasts of classical music, we have caught up with the Old World in mass appreciation of the treasures of the past, and are now keeping pace with Europe in both the quality and the quantity of our native-born performers and composers. Our swift attainment of maturity in musical taste during this century is all the more remarkable when we are confronted with the evidence that during most of the nineteenth century the standards of music-lovers in this country were many years behind those on the other side of the Atlantic.

This decline, however, did not manifest itself until after the 1830's. At the opening of the nineteenth century the state of musical literacy here could in general be favorably compared with that abroad. Pianofortes, usually of British manufacture, adorned the homes of the increasingly prosperous shippers, merchants, and landowners residing chiefly in New York, Philadelphia, Boston, and Baltimore. Imported from London music-publishers were the same popular songs, marches, and waltzes that young ladies of similar station in life played in English drawing-rooms. For the more discriminating, there were opportunities in the cities to hear instrumental music by such eminent composers as Haydn, Dussek, Clementi, and Mozart, performed by professionals, usually French or German emigrés. In 1815 came the founding in Boston of the Handel and Haydn Society, America's oldest permanent oratorio-singing group, which followed closely English tastes in choral music. In Boston also occurred the earliest public hearing in America of an important Beethoven piano composition. A Miss Sophia Hewitt is reported to have played the Sonata in A-flat, Opus 26, on February 27, 1819. Here, too, the manufacture of pianos began to flourish in the 1820's. An American, Alpheus Babcock, produced a piano which was awarded a first prize in 1824 by the Franklin Institute of Philadelphia, organized that year "for the promotion of the mechanic arts."

Philadelphia established its Musical Fund Society on February 29, 1820, and New York its counterpart a decade later, for assistance to elderly musicians, both amateur and professional, and for the performance of orchestral works of high calibre. In the larger American cities, at least, concert programs approached in quality those open to the public in London, Paris, Vienna, or Rome. There was available a great treasury of the masterworks we enjoy today, for by 1830 our heritage had already been enriched by the genius of Bach, Mozart, Haydn, Beethoven, Weber, and Schubert.

Let us not assume, however, that either in Europe or in America the public clamored for these masters. On the contrary, their harmonies were almost drowned out by a host of lesser and, by our standards, superficial compositions, especially those for the pianoforte. Through a series of mechanical improvements, that instrument was rapidly becoming an object of wonder and delight as well as an essential article of furniture in every middle-class home. The classics we revere today had been composed for the earlier, simpler mechanisms and were considered inadequate to do justice to the brilliant possibilities of the newer pianos. The year 1830 ushered in the era of the piano virtuoso, who was most applauded, not when he interpreted the great masters, but when he disguised a favorite song or operatic aria with his own embellishments—trills, arpeggios, runs, and flourishes ranging over the entire recently-expanded keyboard, thus displaying the forcefulness of his arms and the swiftness and delicate coordination of his fingers.

Paris in the 1830's was the center of piano virtuosity. Its leading piano manufacturers, the Erard family, had recently patented the "double escapement" action, the principle on which our modern pianos are built. Pleyel, a rival, then

made other important improvements and opened a concert hall where virtuosos could display their pyrotechnics on Pleyel grand pianos. With the triumph of liberalism over reaction in the Revolution of July, 1830, the French bourgeoisie prospered. Soon thereafter, the Paris Opera House was refurbished in accordance with the lavish tastes of the *nouveaux riches,* and spectacular productions of operas by Rossini, Meyerbeer, Donizetti, and Bellini set the fashion for the world. Piano transcriptions made famous operatic melodies known to those unable to attend the actual performances, just as in these days long-playing records carry New York's musical-comedy tunes to the hinterland. Fantasias, medleys, potpourris, and variations—such was the unsubstantial fare that serious performers were not ashamed to offer at *soirées musicales.* Even such men of genius as Chopin, Mendelssohn, and Liszt launched their careers with bravura-playing.

The mode spread rapidly to cultural centers overseas. Italian opera troupes visited New York and Philadelphia; singers and mediocre pianists, both imported and domestic, reproduced the frothy programs of the Paris salons. But, so far, the really great piano virtuosos of Paris felt no need of enhancing their reputations or increasing their fortunes by touring the United States.

Supreme among such virtuosos was Franz Liszt, who by the age of twenty had written fantasias so difficult to play that only his own extraordinary powers could cope with them. When, in 1831, he first heard the magic of Paganini's violin, he resolved to produce the same almost supernatural effects on the pianoforte. But while he retired from Paris to compose the "Twelve Etudes of Transcendental Execution"—which remain untarnished to this day in the repertoires of our greatest pianists—Liszt's leadership received its only serious challenge.

The contender was Sigismund Thalberg, a year Liszt's junior, and already well along in a career that united all the elements of romance, fame, and fortune. Born in Geneva in 1812, as the natural son of the Austrian Prince Moritz Dietrichstein and the Baroness von Wetzlar, he had every advantage of high birth except his father's title. At the age of ten he went to live with his father in Vienna. Impressed by his son's talent, the Prince gave up his career as an ambassador in order to supervise the boy's musical training. At eighteen Thalberg toured Germany in his first public concerts. As early as 1828 he had played his own compositions—fantasias, variations, and medleys, of course—and his first piano concerto (Opus 5) was published in 1830.

Paris in 1835 gave Thalberg a royal welcome, echoes of which reached Liszt in Switzerland. Critics were claiming that Thalberg's playing was perfection itself; they raved about his extraordinary ease coupled with absolute certainty. Proclaimed one: "His arpeggios at times rolled like the waves of the sea, at others resembled the airy and transparent folds of the finest lace." [1] Said another, "From under his fingers there escape handfuls of pearls." [2] Thalberg's perfect poise and demeanor as a gentleman were contrasted with Liszt's affected fury and spasmodic gestures. Thalberg's compositions were spoken of in the same breath with Chopin's. It was already almost a cliché that Thalberg had captured the art of singing on the pianoforte.

When Liszt hurried back to Paris in December, 1836, to outperform his rival, he found that Thalberg had already departed in triumph. But Liszt lost no time in examining Thalberg's works, especially the "Grande Fantaisie," Opus 22, and "Caprices," Opus 15 and 19, and in launching a savage attack on them in the *Gazette Musicale.* "Emptiness—mediocrity—impotence—monotony!" he stormed. "Arpeggios, everywhere arpeggios and nothing but arpeggios! . . . With the best will in the world, I can find nothing original or charming in all twenty-one pages of Opus 22." [3] A wordy duel ensued in the later issues of the *Gazette.* Professor Fétis, Director of the Brussels Conservatory, and a critic of much influence, defended Thalberg and ascribed the attack to Liszt's professional jealousy. Liszt defended the right of one composer to judge another,[4] and later wrote his friend George Sand that the tempest was worth braving only in the interests of art and truth.[5]

Thalberg, returning to Paris, found the whole world taking sides, with Berlioz leading the champions of Liszt, and Mendelssohn added to his own cohorts. The inevitable musical duel followed on March 31, 1837, at a charity performance at which the tickets sold for the equivalent

[1] Pauer, Ernst, Pianoforte-playing, *Grove's Dictionary of music and musicians (1450–1889)* **2**: 741, London, Macmillan, 1890.

[2] Blanchard, Henri, Thalberg, *Gazette Musicale,* Paris, May 8, 1836.

[3] Liszt, Franz, *Gesammelte Schriften* (L. Ramann, ed.) **2**: 71, Leipzig, Breitkopf und Hartel, 1881–1899.

[4] *Ibid.* **2**: 67–98.

[5] *Ibid.* **2**: 142–145.

of eight dollars apiece. The battle before a crowded *salon* was fought, of course, with operatic fantasias—Liszt, the volcano, thundered his on Pacini's *Niobe,* and Thalberg, the exquisite, counter-attacked with his on Rossini's *Moise.* The winner? In the eyes of the ladies, Thalberg. According to the critics, Liszt.

Liszt's victory had no effect on Thalberg's popularity as a performer, but it did much to dismiss him from further serious consideration in Europe as a composer.[6] Robert Schumann constantly held him up as a horrible example of glittering nullity. Deriding those who imitated Thalberg and considered Mozart old-fashioned, Schumann's critical essays abound in the terms "Thalbergian" and "à la Thalberg" as synonyms of triviality.[7] "So far as solo-playing is concerned," he wrote, "the fourth decade of this century saw it at its highest pitch of executive brilliancy and at its lowest of purpose and feeling —indeed, it may be comprehensively designated as the epoch of Thalberg."

And yet Clara Wieck, who was to become Schumann's bride in 1840 and had already distinguished herself as a concert pianist, included several of Thalberg's works in her repertoire of the years 1833, 1836, 1837, and 1840—although not thereafter![8] Mendelssohn, moreover, continued to be impressed by Thalberg, and, according to Grove, "it is at least possible that not only the E-minor *Prelude,* where a favorite device of Thalberg's is deliberately imitated, but a great number of the *Songs without Words* were more or less consciously influenced by Thalberg's ideal cantabile."

Both Liszt and Schumann, doing their utmost to develop an appreciation of more profound music, especially that of Beethoven, at first encountered the resistance of the public. Even in culture-conscious Paris, the going was rough. To raise money for a monument at Bonn to Beethoven, Liszt offered an all-Beethoven program at the Paris Conservatory on April 3, 1841. It is reported that after he had played the first movement of the *Kreutzer Sonata* with an excellent violinist, the audience became restless. They shouted and stamped for Liszt's fantasia on a popular opera, *Robert Le Diable,* and would not permit the program to continue until he had interrupted the sonata to play the fantasia.[9]

In the next decade, however, Liszt's dedication to the great music of the past and to the lyrical masterpieces of his friends Chopin, Mendelssohn, and Schumann, began to improve musical taste in Europe.[10] But Thalberg's public, at the same time, continued faithful and admiring. He was constantly on tour, playing in Belgium, Holland, England, and Russia in 1839, in Spain in 1845, and as far as Brazil in 1855. Nor did he slacken his output as a composer—he poured out a steady stream of fantasias, caprices, waltzes, marches, and souvenirs, until they came to a total of nearly ninety separate works. They found their way to the United States in both authorized and pirated versions and sold readily. Since they sounded more difficult to perform than they actually were, compositions in the Thalberg manner formed the backbone of the concert programs of his imitators here. During the forties, Leopold de Meyer, Henri Herz and Maurice Strakosch were the most prominent of the European pianists to unfurl their Thalbergian fantasias. From Boston to New Orleans, the country was concert-mad. America's native-born virtuoso, Louis Moreau Gottschalk of New Orleans, produced a number of pieces in the Thalberg manner which were immensely popular, among them: "The Dying Poet" and "Last Hope." When Jenny Lind toured the United States under the auspices of P. T. Barnum, the entr'acte on her program was Thalberg's fantasia on *Norma,* offered as a two-piano duet.[11]

Not until November, 1856, did Thalberg himself appear on our shores. The stage for the historic visit was set well ahead of time by his clever manager, Bernard Ullmann. "Seven Erard pianofortes sent over to America for the concert of one performer!" marveled New York's leading musical review.[12]

> Yes, even so . . . and you will find . . . that he will make one instrument do the work of seven in the hands of ordinary performers. . . . Not a single professional, not one amateur, not one schoolgirl who has but toiled half-way through the pages of Bertini or of Richardson's Modern School [publishers of Thalberg's compositions] will miss the opportunity of listening, if but at one concert, to Thalberg.[13]

[6] Sitwell, Sacheverell, *Liszt,* 44, Boston and New York, Houghton Mifflin, 1934.

[7] Schumann, Robert, *Gesammelte Schriften,* especially 2: 245, 253, 326, Leipzig, Breitkopf und Hartel, 1914.

[8] Litzmann, Berthold, *Clara Schumann* 2: 444, London, Macmillan, 1913.

[9] Loesser, Arthur, *Men, women and pianos: a social history,* 378, New York, Simon and Schuster, 1954.

[10] Sitwell, *loc. cit.*

[11] Loesser, *op. cit.,* 489.

[12] *New York Musical Review and Gazette,* Oct. 18, 1856.

[13] *Ibid.*

Before his debut at Niblo's Garden in New York on November 1, 1856, it was announced that "corrected and authorized editions of such of the great pianist's works as he will perform in America will be published in superior style and at such prices that all amateurs and pianists may own them. These editions will be of his compositions as he performs them now, and not as written years ago." [14]

From the fall of 1856 to the winter of 1858, Thalberg played fifty-six concerts in New York, thirteen in Philadelphia, fifteen in Boston, and also included in his tour Washington, D. C., and Chicago. Madame d'Angri, an Italian contralto, her husband, Signor Morelli, a tenor, the American pianist Louis Gottschalk and the great Belgian violinist, Henri Vieuxtemps, helped to fill out his programs.

"The prince of pianists has arrived at last," was Philadelphia's verdict. "All his concerts in this city have been musical triumphs." [15] And no less enthusiastic were reviewers in other cities. One New York critic, however, said with respect to Thalberg's numerous fantasias: "These compositions are so much known and have been so much talked about that it is useless to add a word about them. In Europe, they have done their services a long time, and if played by the master himself, will even now elicit sympathy and admiration." [16] The extent to which Thalberg was willing to unbend for his public is evident in a report from the nation's capital: "Mr. Thalberg was assisted by the comedians, Mr. and Mrs. Florence, who played the very classical pieces, 'The Yankee Housekeeper' and 'The Young Actress,' and sang several very popular arias, such as 'Bobbing Around' and 'My Mary Ann.' . . . We learn that Mr. Thalberg received no less applause than 'Bobbing Around.'" [17]

In New York, Thalberg showed extraordinary stamina. Often he gave three concerts a day: a morning musicale and an evening recital, with an afternoon concert in Brooklyn. The daytime affairs were, of course, mainly for the ladies—elegant social affairs at which chocolate and ices were served by waiters in knee breeches and white stockings.[18] At the end of Thalberg's first season, a reviewer summed up: "And thus have closed for a time probably the most successful series of concerts, pecuniarly, given in New York since those of Jenny Lind. The artist's bank account must already have arrived at the tens of thousands, as the net result of his first few weeks." [19] Said another astonished observer: "That the number of professional players is legion is a known fact, but that the number of those who in our day, *pay* for pianoforte playing, should also be legion, is a most novel and interesting item in our experience of musical things." [20]

Not content with his impact on adult audiences alone, Thalberg, perhaps inspired by his astute manager, was determined to leave a lasting impression on the younger generation. In a letter sent from the St. Denis Hotel, New York City, dated November 21, 1856, and published, of course, in the press,[21] Thalberg asked for the cooperation of Dr. Lowell Mason, author of the best-selling Mason Hymnal, and father of musical training in our public schools: "Desirous of doing what lies in my power for music while in this country," wrote Thalberg, "it would gratify me to afford the pupils of the public schools of this city an opportunity to attend some of my concerts." Dr. Mason accepted the offer eagerly: "Having had the pleasure of meeting you in 1837 and of hearing you play during that season . . . I was fully prepared to welcome you to this country (destined to become emphatically the land of song)." [22]

The first concert for New York's children took place on December 2, 1856. It is reported that "3000 of the happiest young ladies, selected from fifty ward schools of the city, filled Niblo's Theatre to its utmost capacity." [23] On the stage was the Mayor of New York, Fernando Wood, city officials, the Board of Education, and representatives of the clergy.

Dr. Mason introduced the virtuoso by announcing to the children: "You are to have a specimen of the highest artistic attainments which can be acquired by genius." Thalberg played several operatic fantasias and a gem he had just composed, variations on "Home Sweet Home." Madame d'Angri sang, among other airs, "I'm a Merry, Merry Zingara," and variations on

[14] *New York Musical Review and Gazette*, Nov. 1, 1856.
[15] *Ibid.*, Musical correspondence from Philadelphia, Dec. 13, 1856.
[16] *New York Musical Review and Gazette*, Nov. 15, 1856.
[17] *Ibid.*, Jan. 24, 1857.
[18] *Ibid.*, March 7, 1857.
[19] *Ibid.*, Dec. 13, 1856.
[20] *Ibid.*, March 7, 1857.
[21] *Ibid.*, Nov. 29, 1856.
[22] *Loc. cit.*
[23] *New York Musical Review and Gazette*, Dec. 13, 1856.

"Yankee Doodle," arranged for the occasion. The superintendent of the New York schools, S. S. Randall, Esquire, addressed Thalberg:

> We welcome you, Sir, as a freeman henceforth of this great corporation of public instruction. Your name and fame are already familiar as household words with us all, but many, very many of the children here assembled . . . will bless the day and the hour when they were permitted . . . to listen to the highest triumph of musical art.[24]

Thalberg bestowed two more free concerts on the children of New York, and gave two similar ones to the pupils of the Boston schools the following January.

With thousands of youngsters thus exposed to Thalberg under such impressive auspices, it should not be surprising that in the years that followed most Americans were to regard his works and those of his imitators as the *ne plus ultra* of cultural achievement. Discredited in Europe as a serious composer, Thalberg could continue to have his elegant trifles sold in this country without fearing the competition of Mozart, Beethoven, or Chopin. Before departing from our shores in 1858 Thalberg added a fantasia on "The Last Rose of Summer" to that on "Home Sweet Home." These were to be the mainstay of popular concert programs and family musicales almost to the end of the century—along with "The Maiden's Prayer," by a Polish disciple of Thalberg, which began its vogue here in 1860.

[24] *Loc. cit.*

Opportunities to hear music of higher calibre in America in the fifties and sixties were limited mainly to a few cities. A group of German musicians had organized the New York Philharmonic Society in 1842, but even to the present day its programs must be supported by contributions of individuals. A valiant attempt in 1857–1858 by William Mason and Theodore Thomas to establish musical matinees in New York patterned on those of Liszt at Weimar, for hearing the chamber music of composers like Schubert, Schumann, and Brahms had to be abandoned after its sponsors struggled with deficits for fourteen years.[25]

Meanwhile, in Europe, Liszt and his pupils, especially Hans von Bülow and Anton Rubinstein, were gradually winning over their audiences to an appreciation of the great music that we now take for granted in our American concert programs. Not until 1872 did Rubinstein finally reach this country with his interpretations of Bach, Beethoven, and Chopin. Only then did the general public become aware of its possession of the vast treasury of masterworks which had been in existence during most of the century. Today, Thalberg and his compositions have long since been consigned to oblivion, but we should not underestimate the part he played a hundred years ago in delaying our musical coming-of-age.

[25] Thomas, Theodore, *A musical autobiography* (George P. Upton, ed.) 1: 38-39, Chicago, McClurg, 1905.

THE SCIENTIFIC STUDY OF VALUES AND CONTEMPORARY CIVILIZATION

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(*Read April 26, 1958*)

PHILOSOPHERS tell us that there have been four main approaches to the problem of value: the Platonic view that values are "eternal objects"; the position of subjectivism or of radical ethical relativity; the assumption held in common by certain Marxists, logical positivists, and "linguistic" philosophers that judgments of value are merely "emotional" or "verbal" assertions altogether removed from the categories of truth and falsity; the naturalistic approach which holds that values are accessible to the same methods of enquiry and canons of validity applied to all forms of empirical knowledge.

This last view oriented the work of the Values Project of the Laboratory of Social Relations of Harvard University. Behavioral science may as well resign itself to shallow descriptivism unless it can create the concepts and the methods and techniques required for dealing with statements of value and with non-verbal acts influenced by such abstract standards. Otherwise explanation and prediction will be impossible except at the levels of reflexive behavior, reactions under conditions of extreme physiological stress, and sheer statistical conformance to cultural patterns. For human beings do not respond to stimuli or to a stimulus-field as machines respond to the pressing of a lever. In addition to the human organism and its environment (including other people), there is a third factor, an intervening variable which is not directly observable but is ever present. This is the total apperceptive mass which each of us develops both as a result of our strictly personal experiences and by virtue of our participation in a specific society and in particular sub-groups of that society. Only exceptionally do we react in any literal sense to stimuli as they might be correctly described in physical and physiological terms. Rather, we react to our interpretations of stimuli. These interpretations are derived in considerable part from our culture and from each person's specific experiences in that culture.

Human beings, like other animals, try to maintain their lives, to survive in the struggle for existence. But the human animal complicates his efforts to survive by the use of ideas and symbols. Always and everywhere men say "This is good" and "That is bad." "This is better and that is worse." "This is to be sought and that avoided." "This is preferable to that." Such evaluation is not restricted to what is deemed beneficial or injurious in terms of survival and adjustment. All cultures have their categorical imperatives that go beyond existence and pleasure. Few of us as individuals are content with the mere continuation of physical existence. As Simone de Beauvoir says:

> Life is occupied both in perpetuating itself and in surpassing itself; if all it does is maintain itself, then living is only not dying.

We want to live in particular ways and toward selected ends. When the gap between actuality and aspiration is too great, individuals and indeed whole groups choose death rather than survival. For we human beings are not just pushed by our biological needs and psychological drives; we are also pulled by conceptions of the right, the good, the desirable.

Each people's way of life is distinctive precisely because it involves selection between various possible manners of surviving. There are many ways of life which different groups of men have created for themselves in the historical process and in response to the pressures in which these distinctive ways of life have developed. What men have created they can and do alter through time to a significant degree. Each way of life is a pattern —not a mere haphazard collection of customs. The expectations, demands, and irritabilities of a people, whether expressed in economic, political, or moral terms are all manifested in terms of habits of thinking which individuals consciously learn and unconsciously absorb in their daily social experience. Each pattern depends to considerable degree upon the underlying system of ideas and particularly of ideas about values. What men do and refrain from doing is much influenced

by what they feel to be the proper modes and ends of existence.

Western civilization is at present the victim of a certain onesidedness in its own growth. In Faulkner's words: "Man's tragedy in the hateful complexity of the present is that he is called upon to live beyond his emotional and moral means." The result is personal and social disorganization, individual unhappiness and human misery on a vast scale, irrational political movements which both manifest and add to these disasters.

Basic to these conditions is uncertainty about and conflict over values. Both aesthetic and moral values are universal in all cultures. Religions have been the traditional respositories of moral values and sometimes of aesthetic values as well. It is an induction from the evidence at the disposal of the anthropologist that religion in the broad sense is essential to the health and survival of any society. That is, there must be codes which unite individuals in adherence to shared goals that transcend immediate and egocentric interest. There must be intellectually and emotionally acceptable orientations to some of the deeper inevitables such as death. There must be communicable symbolisms that appeal to the eye and the ear and the viscera. There must be expression in personal and group ceremonial. On all these points there is now little unity in the West. Belief in God as revealer, judge, and punisher has greatly weakened and with this a whole set of sanctions for adherence to established values. An increasing number of men and women reluctantly accept death as probable annihilation, however much they may continue their formal participation in the Christian church as an institution. Moreover, it is widely recognized that a civilization of the grandeur of whose achievements we are justly proud has nevertheless failed humanity in many ways. Neither Christianity nor Humanism was able to prevent the brutality of Auschwitz and Buchenwald nor the mass slaughter of Hiroshima and Nagasaki.

In this time when Western civilization has begun to doubt its own credentials, Communism's strength is built upon this weakness as well as upon empty bellies, agrarian problems, anti-colonialism, and the like. Hungry for order and certainty, men flock to systems like Fascism and Communism. Their propaganda appeals to the fear of freedom. It capitalizes upon that unconscious flight from the heavy burden of individual responsibility that an open society lays upon its members. Both Communism and Fascism are aspects of a frightened retreat from the frustrations and terrifying diversities of the twentieth century—the main psychological reaction of the masses to anarchy, economic-intellectual-political-evaluative. Marxism advertises itself as a new synthesis which reduces to order the baffling processes of social, economic, and scientific life. It remains a promise, however false, of order in a disorganized world.

The current struggle in the world is basically a war of ideas, of value systems. Although some Communists dismiss ideas and values as "verbal rationalizations," the spread of Communism is itself the most striking testimony to the power of ideas not only over the minds but over the acts of men. Communism is a kind of worldly religion which appeals to the disadvantaged, the frightened, the bewildered, the worn out with struggle and disillusionment. In the long run the Achilles heel of the West is in the realm of ideas and values. In this war we are currently on the defensive. We know many things we don't want. We have some values, precious to us all, which we want to preserve. But we lack positive and innovating formulations. Our program is overwhelmingly negative and conservative (in the strict etymological meaning of that term). We lack a system of general ideas and values to give meaning to human life in the mid-twentieth century. We live in a period when all of our universals have been challenged.

We can huddle back into the older orthodoxies. We can bear chaos as best we are able and wait for the miracle of a new religion to occur—this is what some of our "wise men" seem to be telling us to do. Or—and this is my thesis—we can bring scientific method and outlook to bear upon these problems. Dewey has warned us "a culture which permits science to destroy traditional values but which distrusts its power to create new ones is destroying itself."

In the bewilderment and splitting of Western thought Communism makes its claims to be the one "scientific" unifying system. In countries like France and Italy a sizable proportion of members of the Communist Party are idealists in the sense in which, historically, we of the Anglo-Saxon tradition were idealists. That is, they think they have in Marxism an answer to the meaningless confusion that they have seen, and they are powerfully drawn and powerfully motivated by the explicitness and comprehensiveness of this scheme. The values that in fact bind most Western men together remain implicit and un-

formulated and backward-looking. I think we shall lose the cold war and a possible hot war if we continue to fight with the technology of 1958 but with the ideas of 1858.

Even our language—both in the literal sense and in the figurative sense of our way of thinking—is utterly inadequate to express what we in actuality know about ourselves and the world in which we live. The common language of an optimal way of life must take account of two scientifically obtainable bodies of knowledge: the needs, potentialities, and limitations of the human animal; the physical world that is the context of human existence. Northrop has argued that the culture of any people rests, in the last analysis, upon that people's philosophy of nature. I should have said "argued in a new and more sophisticated manner," for the basic conception is at least as old as Plato and Aristotle. And the Catholic Church was right, given its premises, to insist that Galileo should recant. The theologians of that day saw quite correctly that a system of religion and morals is not much stronger than its accord with those notions of ultimate natural reality which are the keystones of all cultures.

Northrop explains the ideological conflict between the democracies and the U.S.S.R. by stating that the former's assumptions came from the results of Galilean and Newtonian physics, while the Russian assumptions derive from the results of mathematical physics in the first half of the nineteenth century. He urges upon us the necessity of getting some objective criteria outside the social sciences and humanities against which the postulates of these subjects can be checked.

Whether these contentions be correct or not, it is certainly true that there has developed a tremendous time lag between the picture of "physical reality" held by scientists and the working philosophy of the ordinary educated citizen. In part, this is because specialism has gone so far that we are approaching, if we have not reached, the point where each scientist can communicate with only a few people on earth when it comes to highly technical matters. John Burnet, a generation ago, said:

> This system, if pushed to its logical conclusion, would land us in a society where no one knew anything that anyone else knew. The mass of men would take refuge in scepticism, and the dark ages would be upon us at once.

Possibly it is already later than we think. Surely our general ideas, which are the vital stuff of all civilizations, are remote from the frontiers of physical science. And our deepest beliefs are already weakened by some centuries of criticisms of the foundations of our central myths and by echoes at least of the revolutionary view of the world of nature that has emerged from science in this century.

Each culture is necessarily characterized by a conception of human nature and indeed of nature generally. Such conceptions constitute unifying philosophies—not the less powerful because the average man in any culture cannot give fully articulate statements of them. One of the outstanding properties of the human animal is the need "to make sense out of life," to possess ordering standards that give significance to his life and to his working with others toward goals in accord with values felt and believed in. Our contemporary deficiency is not only the malintegration of these standards but equally the fact that the scientific knowledge relevant to them is largely restricted to scattered groups of specialists.

The human sciences in the West are approaching the creation of a picture of human nature, its capacities and limitations, which could be one foundation of a way of life less distorting, less tension-ridden than any heretofore imagined. The Soviet Union is far behind in this respect—particularly because of its neglect of the unconscious, irrational, and nonrational factors in human living. I think there are good reasons for believing that the ideas which can give rise to new and better ways of life for all humanity will come primarily from the non-Communist world. I do not believe that the resources of Western thought—to say nothing of the potentialities of the free countries of Asia and Africa—are exhausted. The resources of Western thought are merely—at present—too split and diversified. Our diversity, however, is our strength as well as our weakness of the moment. Out of its many strands can come a more true and more powerful conception of human nature. The conceptions both of the great world religions thus far and of the secular religions have been incomplete and inaccurate. Hence they have alike failed in their highest aspirations.

Nor is it only scientific knowledge of human nature which is pertinent. The Confucian concept of *jen* considers nature in general the court of last resort. It seems to have been Confucius and the Greek philosophers who gave the world its first systematic notions of how human beings might derive their values in other than an au-

thoritarian manner and with the possibility for change and growth. Central to the Greek conception of virtue was the striving for congruence between behavior and knowledge. For Plato critical intelligence is virtue, for Aristotle it can be virtue. Both Plato and Aristotle brought values within the sphere of science, making virtue something discoverable and teachable rather than revealed, handed down, and only preachable. The Stoics specifically proclaimed that "to live in accordance with nature" was the highest good. Cicero speaks as a Stoic when he says that "right is founded not in opinion, but in nature."

It is unfortunate that in the Western world during the last century and a half a divorce between nature (as described and interpreted by science) and values has generally been accepted. This is embodied in the famous dichotomy between the *Naturwissenschaften* and the *Geisteswissenschaften*. It is expressed colloquially in such utterances as "Science provides only a car and a chauffeur for us. It cannot, as science, tell us where to drive." I suspect that the division of territory which ascribed to science the realm of "fact" and to religion and the humanities the realm of "value" was, in effect, a temporary resolution of the so-called "conflict between science and religion" which plagued the nineteenth century. The forces of orthodoxy saw very clearly that new knowledge of the physical universe threatened credulity in the cosmogony of Genesis; that palaeontology, biology, and archaeology had deprived much of the Old Testament of other than possible symbolic meaning. During that period organized religion still had great power to block scientific teaching and research. In substance, the scientists were offered a compromise: "You may investigate the non-human world of nature to your heart's content so long as you admit that problems of morality, of ultimate values are, in principle, *ultra vires scientiae*."

Communism—and all other forms of totalitarianism—are, among other things, a reaction to certain inherent weaknesses in the value position of democracies from Greek times to our own. The democracies have always had an inherent drift toward relativity in values, possibly toward anarchic relativity. I do not believe this is inevitable if relativism is balanced—as the facts demand—by universalism on some broad but important issues and if relativism is itself conceived as an ordering principle rather than as tolerance of chaos.

Equally incorrect are the views that "science can have nothing to do with values" and the moral nihilism inherent in the vulgarizations of, say, the older psychoanalytic and anthropological standpoints. There is an alternative between dogmatism and anarchy. Ethical relativity correctly saw the diversity of actual moral codes among different peoples and quite rightly pointed to scientific and logical flaws in specific theological and metaphysical systems of ethics but quite wrongly concluded that there were no pan-human values and that every value judgment had to be considered exclusively in its unique context.

Let me comment upon the present position. At the outset, however, I should like to make it quite explicit that I do not claim for science, any more than for any other field, a monopoly on the study of values. I do agree heartily with H. J. Muller's recent statement that ". . . values are as legitimate a subject of scientific investigation as any other phenomena pertaining to living beings." But science in and of itself will not "solve" the problems of value. Science does have some important, indeed some indispensable, contributions to make. And some ghosts still need to be laid.

First, the existence of value judgments does not make behavioral science impossible in principle. It is true that the sociology of knowledge has shown how the selection of facts and the construction of theories is indeed conditioned by cultural and individual compulsives. Nevertheless, this is simply a special case of the proposition that all discourse proceeds from premises and that its validity is limited by those premises. This is equally true of physical and biological science. The important thing in all cases is that the independent critic should be able to scrutinize the premises as well as the data. It is required in the case of behavioral science that the values both of the investigators and of the cultures and individuals being studied be made explicit.

Second, values are cultural and psychological facts of a certain type which can be described as objectively as other types of cultural and psychological facts. Fundamentally, one does the same as in other areas of behavior: one listens to what people say and for what they fail to say; one observes what they do and don't do; one gets at what they are unable or unwilling to say by projective tests, "depth interviews," and other techniques.

The circumstance that at present we meet with difficulties in the description of values is a function of our inexperience. Data are never in themselves "tangible" or "intangible." Our *methods*

at a given time point do fall toward one pole or the other. Thus far we have magnified out of all proportion the distance from the indicative to the optative and imperative modes. Yet Charles Morris has demonstrated that factual, wish, and appraisal sentences all have empirical, syntactical, and pragmatic or technic reference, but they differ in the degree to which various elements of reference are present. In any event it is comparatively simple to establish the stated standards of the right and the good held by an individual or the modalities in a population. Less easy—but the work of the Values Project and other empirical studies have proven its feasibility—is the description of preferred paths of behavior that take their direction from varying conceptions of the desirable. In situations where, from the point of view of the observer, there is more than one way open to the meeting of a need or the satisfaction of a want, individuals and groups exhibit stylized preferences derivable from their notions of normative relations between actor or organized group and the press of the environment.

Third, it seems abstractly evident that science can say something about instrumental values as appraised in terms of their relative efficacy as means to designated ends. The psychologist, E. L. Thorndike, in a famous presidential address to the American Association for the Advancement of Science says:

> Judgments of value are simply one sort of judgments of fact, distinguished from the rest by two characteristics: they concern consequences; they are consequences to the wants of sentient beings. Values, positive and negative, reside in the satisfaction or annoyance felt by animals, persons, or deities. If the occurrence of X can have no influence on the satisfaction or discomfort of anyone, present or future, X has no value, is neither good nor bad, desirable nor undesirable. Values are functions of preferences. Judgments about values—statements that A is good, B is bad, C is right, D is useful—refer ultimately to satisfactions and annoyances in sentient creatures and depend upon their preferences. Competent students judge the existence of things by observations of them; they judge the values of things by observations of their consequences.

Thorndike faces honestly up to the problem of what kinds of satisfaction and the problem of weighting—satisfactions for whom, in what amounts, when. His approach has at least the merit of being an extensional, non-Aristotelian system based on asymmetrical relations involving "more," "less," etc. In an Aristotelian system, in which both the similarities and differences of predicates give us merely symmetrical relations, we cannot have a working theory of evaluation. Thorndike sees very clearly that many important questions cannot be answered with an unrestricted yes or an unrestricted no. He correctly points out that we cannot at present answer in detail the question of what satisfactions for whom because our knowledge of human nature and of consequences of particular courses of action is insufficient because insufficiently studied. He says:

> The only safe way to gratify human wants and fulfill human aspirations is by learning the regular predictable modes of action of nature, especially those which relate to these wants and aspirations. . . . Every regularity or law that science can discover in the consequences of events will be a step toward the only freedom that is of the slightest use to man, and an aid in the good life. If values did not reside in the orderly world of nature, but depended on chance and caprice, it would be vain to try to increase them.

Like Thorndike, I am convinced that, if science can chart reliably some of the remote as well as the immediate consequences of various possible courses of action, men's conceptions of the desirable will be clarified and modified.

But, if instrumental values can be tested scientifically in the light of their consequences under the conditions that prevail, the consequences in turn must be looked at in the framework of more ultimate ends. Only to some degree can these be regarded as "given" by nature or the human condition. There is doubtless something to the principle which the Gestalt psychologists call "intrinsic requiredness." That is, the nature of the human species is such that some needs and wants can be fulfilled in only certain ways, or some fulfillments are basically more appropriate than others. It is not, however, a simple question of "needs" and "wants" as determined by physical and biological necessity. Behavioral scientists sometimes equate "value" with the "drive strength" of the experimental psychologists or the "cathexis" of the clinical psychologists. This seems to me a mistake. For, if all we refer to by "value" is the motivational disposition of the organism, we already have a sufficient repertory of concepts. Biological drives and environmental pressure are only obliquely pertinent to the realm of value. Indeed I would assert that the category of "value" becomes useful only when we are dealing with behavior that is influenced by perduring standards

which do not arise from and may be in conflict with the individual's desires at a specific moment and in a particular situation. To speak of "values" is one way of saying that human behavior is neither random nor solely "instinctual."

The individual gets these abstract, perduring standards primarily from the culture or sub-culture as mediated by parents and other persons from whom he learns and portions of whose—if I may be permitted psychoanalytic terminology—"super-egos" he "introjects." As Lyman Bryson has said:

> Our culture teaches us what to want and then sets the rules of the game and provides the stakes and calls the winners. Within the closed world of values that is our culture we learn to want things, and we try to get them, and we judge ourselves and the cosmic plan by whether or not we do get them.

This brings us to some complex issues. Can science contribute to the appraisal of cultures? It must be admitted that the attempts thus far made by anthropologists are crude and unsatisfactory. Leslie White has proposed the per capita energy production per year. He claims that this has increased from one-twentieth of a horsepower per person "at the beginning of culture history" to 13.5 horsepower hours per day per capita (in the United States in 1939). But the cultures of Western Europe, the Soviet Union, and the United States are all based today upon essentially the same technical foundation. From the point of view of White's "social evolution," they all manifest common features commensurate with the technology that provided the conditions for their emergence. And yet they remain very different as regards values. White's criterion "in terms of the extent to which and the efficiency with which human needs are satisfied by cultural means" begs the whole question of value in favor of materialism.

The standard proposed by V. Gordon Childe is also unsatisfactory, though life expectancy may be a more sensitive indicator of level of material civilization. Childe would have us judge "changes by the extent to which they have helped our species to survive and multiply." Survival and multiplication are linked, and both are measured by the biological standard of population increase. The sheer operation here is objective enough again, but how many will agree that the criterion is sufficient? To follow either White or Childe would be to purchase simplistic objectivity at too high a price.

Nevertheless, I believe there are some barely reconnoitered terrains of ultimate or intrinsic values which ought to be explored thoroughly by scientific methods. One is a thorough empirical examination of the relation of instrumental and ultimate values in specific cultures. Are the culturally supplied means harmonic with the ends? What proportion of the population *can* approximate to the culturally defined goals? An answer to this question would not, of course, dispose of the problem of having to act as a moral man in an immoral society but it would supply a basis for comparing cultures as to degree of integration and "realism."

Second, a rigorously factual and comprehensive cross-cultural study of values and their linkages should be instructive. On the basis of what is now known to me, I suspect that one would conclude that both instrumental and intrinsic values may turn out to be either: (*a*) "free"—i.e. "taste" values, or (*b*) cultural values that are local in time and space, or (*c*) universal values embodied in all cultures.

Let us take a somewhat trivial example of an instrumental "taste value" which varies both at the individual and cultural levels. From the point of view of protection against the weather and preservation of modesty, a Japanese kimono or the flowing garb of a desert Arab or a Oaxacan huipil are about equally effective. Yet one would be amazed to see huipils or Arab dress in the streets of Kyoto. Similarly, if one observes acutely enough, one detects amid the superficial similarities of Kyoto kimonos a stylized discrimination characteristic of each individual. One woman prefers certain colors and slight peculiarities of cut. Another woman will use only silk from a particular factory. There are also innovations, most of them initially slight. In the last analysis it is clearly from individual variability that new cultural values take their origin.

"Taste values" represent, as it were, "free choices," conditioned only by the accidents of history and the biological variability of individuals. Some cultural values, however, that are distinctive of particular epochs and places presumably represent responses to the requirements or stimulation of these specific environments, at present or, more often, in the past. Thus, high status given to women may reflect the role they played in the subsistence economy or in the ritual that was presumed to protect and enhance that economy. Or, the high value Americans place upon

technology is surely related to our long preoccupation with conquering a new continent.

Finally, there are those values that, in some form, are built into all cultures: prohibition of incest, a concept of unjustifiable killing, conformity to the dictates of the culture itself, speaking the truth, and others. The details of prescription and proscription vary; symbolizations vary. Yet the central idea is always there. The existence of these universal values raises many interesting problems. They are one evidence of our common humanity, but this fact does not, as some have concluded, lead directly or inevitably to human brotherhood. The universals constitute similarities rather than identities, and history shows that men can have as deadly quarrels about small differences and modes of implementation of ultimate values as they can about the ultimates themselves. Nor can one proceed glibly from the "is" to the "ought." A universal may not be facilely transmuted into an absolute. When confronted with the anthropological evidence, many philosophers very properly ask: "why ought I or anyone else accept as obligatory or worth while what men universally or almost universally have taken as obligatory or worth while?" Still—given the amazing gamut of cultural variability in most respects—I would argue that the burden of proof is upon those who deny that the universals rest upon factors of intrinsic necessity or appropriateness.

The third area that requires working through is that of the mutual implications of cognitive-existential and normative propositions. Northrop's doctrine is not that of a naive social Darwinism in which values are deduced from supposed natural science knowledge. Rather, he insists that none of the primitive categories or primitive postulates of a value system must be contradicted by validated natural science knowledge of physical and biological nature.

Moreover, theory construction in the behavioral sciences must not be based upon generalized notions of natural process which have been abandoned or sharply modified by physical science. Much present confusion in the area of values rests upon the supposed distinction between means-end and cause-effect relations derived from a unilateral, atomistic view of causality no longer held in most aspects of natural science. The machine models of classical mechanics continue to underly too much of our thinking in the behavioral sciences. We need to re-orient ourselves along the lines indicated by the English biologist, J. Z. Young, in his remarkable little book, *Doubt and Certainty in Science:*

> Each human society usually has some central model as the canon of its system, a symbol that provides . . . something that everyone agrees is important, so that conversation and writing can proceed . . . the more we come to know of the flux of chemical changes in the body the more one great weakness of the machine analogy stand out. The concept of a dynamic organization, such as that of a whirlpool, demands a consideration of time—of before and after and of the gradual development and change of pattern, but the machine models of physiology allow no place for this element. . . . Individual chemical atoms remain in the cells for only a short time; what is preserved must be the pattern in which all these interchanging atoms are involved. . . . Biology, like physics, has ceased to be materialist. Its basic unit is a non-material entity, namely an organization. . . . The early scientists . . . compared the universe and the human body with machines—that is to say with our tools. Now we are learning to speak by comparison with human and animal populations, which present the widest expression of continuity that we know. What will be the results of this change? There are already distinct signs that in future there will be less sharp separation between physical, biological, and sociological science than there is now. All of these scientists report the behaviour of the same population of observers. . . . The aim of the new unified science might be said to be to define those relations between populations of people that enable them to communicate information and so to maintain life. This is the way of speaking that can unify all our scientific activities. That, of course, does not mean that we may not be able to doubt it in the future; one may expect that further and better models will be developed, just as this one is now arising out of previous systems.

Each culture is based upon conceptions of nature and of human nature. Often these conceptions are left largely unstated and unexamined—and are the more compelling for that reason. But in the end bad theory falls under the force of logical analysis and stubborn and irreducible fact, and new and truer theories are built. They can be built upon knowledge of the nature of the world and of the nature of man as one part of the world of nature. The proper postulates can be discovered by scientific enquiry, to the extent that we will look at the world and our experience in it freshly, divesting ourselves to the necessary degree of the blinding preconceptions of our particular cultures.

Both in the East and the West conceptions of human nature urgently require re-examination.

There is, for example, much greater similarity among the cultures of the world than appears superficially. The attention of anthropologists and others has been caught too preponderantly by the differences. Both things are there: the similarities and the differences. The similarities result from the similarities in human biology and in the human condition, regardless of culture, and from the fact that every culture has to make some provision, however limited, for the variety of human temperaments which is the consequence of biological variability.

To the general proposition that the behavioral sciences have a contribution to make to the understanding of human nature and especially of its nonrational and irrational components, I call to witness a humanist, the Regius Professor of Greek in the University of Oxford, E. R. Dodds:

> We too have witnessed slow disintegration, starting among the educated classes but now affecting the masses almost everywhere, yet still very far from complete. We too have experienced an age of rationalism, marked by scientific advances beyond anything that earlier times had thought possible, and confronting mankind with the prospect of a society more open than any it has even known. And in the last forty years we have also experienced something else—the unmistakable symptoms of a recoil from that prospect.
>
> Is it the hesitation before the jump or the beginning of a panic flight? Once before a civilized people rode to the jump—rode to it and refused it.
>
> Was it the horse or the rider? I believe it was the horse—those irrational elements in human nature which govern without our knowledge so much of our behaviour and so much of what we think is our thinking. And if I am right about this I can see in it grounds for hope. The men who created the first European rationalism were never—until the Hellenistic Age—*mere* rationalists. They were deeply and imaginatively aware of the power, the wonder, and the peril of the Irrational. But they could describe what went on below the threshold of consciousness only in mythological or symbolic language; they had no instrument for understanding it, still less for controlling it; and in the Hellenistic Age many of them, too many of them, made the fatal mistake of thinking they could ignore it. Modern man, on the other hand, is beginning to acquire such an instrument. It is still very far from perfect, nor is it always skillfully handled; in many fields, including that of history, its possibilities and its limitations are still to be tested. Yet it seems to offer the hope that if we use it wisely we shall eventually understand our horse better; that, understanding him better, we shall be able by better training to overcome his fears; and that through the overcoming of fear horse and rider will one day take that decisive jump and take it successfully.

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ALBERT CAMUS, AN ANTI-CHRISTIAN MORALIST

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(*Read April 25, 1958*)

On December 10, 1958, Albert Camus, aged forty-five (the second youngest writer to be thus honored, the first having been Rudyard Kipling), received the Nobel Prize for Literature, "for his important literary production, which with clear-sighted earnestness illuminates the problems of the human conscience in our time." In a modest and noble speech of acceptance, the French writer defined his writer's function as he conceives it, repudiating art which is a solitary delight and which isolates the artist from the community of men. Like almost all the French writers of the present century, Camus is a moralist even more than a story-teller. The peril is great for a writer thus to observe life from some altitude instead of creating living human beings and of allowing his ambiguous message to be diversely interpreted by his readers. André Gide, André Malraux, François Mauriac, Georges Duhamel, Jean-Paul Sartre have all tended, after the early outburst of their imaginative talent, to prefer the imparting of abstract truths to the molding of ordinary mortals enmeshed in the coils of a fictitious tale. At an even earlier age than they, Camus was, like many of our writers at the present mid-century, seduced by parables. Never since the Middle Ages has allegory enjoyed such favor. Posterity may well frown upon those artists who were so engrossed by the anguish of their contemporaries that they sought to alleviate it through diagnosis and spiritual cure, instead of making it live dramatically for ulterior eras. But "hic et nunc" is the motto of most moderns. Camus has assumed or accepted the role which American, Scandinavian, Argentinian, and Japanese readers lately ascribed to him when, answering a questionnaire, they voted him to be the favorite guide of this generation.

Surprisingly enough, that moralist who has more than once upbraided Christianity and who may well be characterized as determinedly anti-Christian, has aroused most sympathetic interest among Christians. As early as 1945, in the October and November issues of the important Jesuit review *Etudes,* he was presented by Jean du Roustu as "a Pascal without Christ." In April, 1949, the leading Dominican review, under the signature of L. Roynet, likewise commented with respect, almost with envy, upon the "passionate unbelief" of Camus. The phrase, "incroyance passionnée," had been coined by Camus himself in an essay devoted during the war years, in the *Cahiers du Sud* of April, 1943, to a modern saint, M. Pouget. A Belgian churchman, Charles Moeller, who handled authentic Christian writers like Simone Weil with querulous severity, could not conceal his leniency toward Camus, whom he treated first in the first volume, subtitled "Silence de Dieu" of *Littérature du vingtième siècle et christianisme* (Casterman, 1953). In this country, the best work thus far devoted to Camus is by Thomas Hanna, a professor of religion at Hollins College, Va. With an insight which does them credit as Christians and as critics, Protestants and Catholics alike sensed that a philosopher of the absurd and a portrayer of nihilism could point the way to a tautening of the religious fiber in many a believer, apt to allow Browning's warning, "How very hard to be a Christian!" to slip from their minds.

The experience of World War II rocked men like Camus and Sartre to their foundations, and it would be revolting if it had been otherwise. Yet the key to their thinking which, moving along parallel lines at first, subsequently parted ways, is to be found in their early, pre-1940 writings. Camus, the North African, the young student of philosophy in love with the concrete, brought back to the enjoyment of life by two masters who had themselves striven hard to renounce a bookish moroseness and to preach joy, Nietzsche and Gide, never expressed himself more directly than in *Noces* (1938) and in the essays collected in *Eté* (1954). "I learned that there was in me an invincible summer," Camus declared in the second of those books. The sun radiates in his early pages, vibrant with the romantic delight in beauty and in action. The "Noces" are the hymeneal

feast of the sun, the earth, and the sea along Mediterranean shores. Camus, born in the land of St. Augustine, whose relationship to Plotinus he had studied in an early philosophical essay at the University, instinctively goes to the Greeks to find his roots. Since the Greeks, he laments in "Exil d'Hélène," one of the pieces in *Eté*, we have banished beauty and the acceptation of our limits, and cherished tragedy with an unhealthy predilection. Camus' paganism in no way smacks of Epicurean indulgence; its intoxication is with sobriety; its most ardent yearning is for moderation; its wrath is aroused by the Christian insistence upon sin.

> For if there is a sin against life, it consists not so much in despairing of life as in hoping for another life and in robbing oneself of the implacable grandeur of this one.

Man's fate is absurd, for all he has reason to wish for is denied him. He wants a rational order in the universe and he is faced with baffling irrationality. He wants clear-sightedness and all, even his own soul, is chaos. He yearns for the continuation of life after death, but soon realizes that nothing justifies such a fond delusion. The awareness of the absurd is that of a dissonance between man's aspirations which his reason deems to be legitimate and the conditions imposed upon him. In the presence of absurdity, man may be tempted by suicide: but suicide, as Camus argues in the *Myth of Sisyphus*, would only withdraw the one element, man's conscience, which protests against the senselessness of a world not attuned to man's wishes. Suicide is the most serious of philosophical problems, but it is very far from constituting the one solution to which he who sees no transcending meaning to life is driven, for it is an escape. Absurdity leads, not to abdication, but to revolt.

The other escape is hope, the Christian way of tolerating existence in this vale of fears. Hope is spurned by Camus, as it was by Alfred de Vigny, with whose *Journal d'un poète* the North African moralist has many affinities. "Christ's religion," Vigny had jotted down in 1834, "is one of despair, since He despairs of life and hopes only in eternity." Camus indicts hope as a form of resignation, for it has too often served as a selfish screen to those who are readily resigned to the suffering of others.

> From Pandora's box, where swarmed the evils of mankind, the Greeks let out hope after all the rest, as the most dreadful of all. I cannot imagine a more moving symbol. For hope, in spite of what many believe, is equivalent to resignation. And to live is not to be resigned.

Those who in the past have set their hopes on "otherness," on another life in which the injustice and the illogicality of this one would be redressed have too often failed to turn with enough persistence, "hic et nunc," against what has gone awry in their own microcosm. Camus, in this respect, as in several others, comes very close to other French Existentialists despite his refusal to be aligned with them and reserves his most outspoken disapproval for those who justify imperfect institutions and their own actions on the basis of eternal values or of some divine revelation. He is too much of a Greek to bow before the voice out of the whirlwind which silences another rebel, Job, with such poetical rhetoric as "Where wast thou, when I laid the foundations of the earth? . . . Knowest thou the ordinance of the heavens?" The Greek asserted his right to question. His heir, the modern humanist, will reject both Marxism and Christianity, since both gladly sacrifice the present to the future, man's rightful claim to happiness ("There is no shame in being happy," pronounce *Les Noces*) to the advent at some remote future of the triumph of the proletariat or of an ultimate justice.

Let it not be said that such a faith, immolating man to the victory of an abstract hope, affords men the security for which they crave. "Insecurity, that is what makes us think," one of the characters in Camus' *Caligula* exclaims. It is indeed "mortal's chiefest enemy" as Hecate declares in the third act of *Macbeth*. Better live with our stress and strain than abdicate them in order to avoid thinking and to soothe our velleities of revolt against injustice: history bears witness to many a compromise consented to by religious authorities. The French, haunted as they are by Pascal and ever ready, as they have again been in 1955–1958, to acclaim an austere play on Port-Royal, have never forgiven the Jesuits who, against the more rigid doctrinaires of Jansenism, advocated in the seventeenth century compromises, involving casuistry, between religious teaching and men's frailty. The same zest with which they quarrelled then on theology has since been transferred to politics, that heir to theology among us. Thoughtful observers of our age have been dismayed by the immoral use to which Christ's answer to those who asked Him whether it was

lawful to give tribute money to Caesar has been put by many dignitaries of the Church. The acquiescence with which the Vatican rallied to a pact with Fascism in Italy, with which Austrian and German cardinals, Lutheran pastors, Spanish archbishops welcomed Hitler and Franco, has left scars in European Christianity.

Camus does not condescend to vulgar anti-clerical polemics. He is well aware that neither Christianity nor Buddhism nor democracy can fairly be judged on their failures to live up to too lofty an ideal. Like many French Resistance fighters, he learned during World War II how to appreciate the priests alongside whom he waged a stubborn battle of ideas against the tyranny which tried to crush the right of thinking men to a free dialogue. But he failed to agree that there lay in Christianity a higher conception of justice than in the religions which had preceded it. On September 8, 1944, in an article of his courageous newspaper *Combat* which, with the liberation of Paris, then appeared in the open, he declared: "Christianity in its essence is a doctrine of injustice. It is founded upon the sacrifice of the innocent [1] and the acceptation of that sacrifice. . . . Justice, however, does not go without revolt."

Two years later, in 1946, Camus was asked to speak to the Dominicans of La Tour Maubourg, on the Paris Left Bank, and an account of his address appeared in the Dominican review, *La Vie Intellectuelle*, in April, 1949. He made his position clear as that of a non-Christian. First, it was the sad disappointment of one who, among millions, had vainly expected, during the occupation of most of Europe by Germany and the systematic extermination of millions of human beings, a voice from Rome which would have brought solace to Christians. Then he brooked impatiently the hypocrisy of many Christians who affected to condemn agnostics and especially the Existentialists for their pessimism; pessimism was on the side of the Christians themselves: "misery of the creature, the 'nemo bonus,' the damnation of unchristened children, man having no hope except in God's grace." Unlike Christ, Camus boldly advanced, he was "a pessimist where man's destiny was concerned, an optimist where man was concerned." Third, he lamented the absence in Christianity of "the virtue of revolt and of indignation which it once had." If, as Christ says in St. Matthew, "the kingdom of heaven suffereth violence, and the violent take it by force" (11: 12), there must continue to exist men who rebel against a universe deemed by them to be unacceptable.

In the same newspaper *Combat*, on January 11, 1945, Camus published a stern reply to Mauriac, who, with the complacency of the firm believer, had remonstrated with the agnostics who clamored for justice and proposed to them charity as the higher virtue. Weary of thus having the name of Christ thrown in his face, Camus gravely replied:

> I believe I entertain a just idea of the greatness of Christianity; but there are a number of us in this persecuted world who feel that, if Christ died for certain men, He did not die for us. And at the same time we refuse to despair of man. If we do not cherish the unreasonable ambition to save him, we wish at least to serve him. We consent to be deprived of God and of hope, but not to do so easily without man.[2]

Such a revolt against God, typified by Sisyphus, the favorite hero of this generation, differs markedly from the nineteenth-century revolt personified in Cain or in Prometheus. From the Romantics to Nietzsche and Ibsen, the men of the last century had been fascinated by the myth of the superman. Like Dostoevski's Kirilov, like Swinburne in his blasphemies of *Atalanta in Calydon*, they denied God in order to deify man. There lingered much religion, even if inverted or perverted, in their frantic desire to force man to transcend himself and "to become God" as Musset in an early poem and E. A. Poe in his "Mesmeric Revelation" had expressed it. With arrogance, doubtless, but amid many an agonizing fall from the heights which they attempted to scale, those precursors of Nietzsche refused to be content with man's fate. They proved true, in their quest for transcendence, to Aristotle's warning in the chapter "on Happiness" of his *Nichomachean Ethics* (X, 7):

> We must not follow those who advise us, being men, to think of human things and, being mortal, of mortal things; but must, so far as we can, make ourselves immortal, and strain every nerve to live in accordance to the best thing in us.

[1] An allusion to the sacrifice of Christ, obviously. Elsewhere, and chiefly in the half ironical novel *The Fall*, Camus alludes scathingly to the Massacre of the Innocents (Herod's massacre of the children of Bethlehem as told in St. Matthew) commemorated by the Church.

[2] This passage and the one quoted just above have, like several of Camus' articles in *Combat*, been reprinted in the first of the two volumes of *Actuelles* (Paris, Gallimard, 1950).

The originality of Camus and of those of his age group lies in their refusal of transcendence. They want to remain in a human realm, in which the replies are human. Fidelity to one's limits and clear-sighted love of one's condition are the lessons learned by Camus from the Greeks. In *The Myth of Sisyphus,* he asserts:

> Yes, man is his own end, and he is himself the only end to which he can aspire. If he wants to be something, it is in this life. . . . Tense faces, fraternity ever imperiled, strong and shy friendship of man for man, these are the true riches, because they are mortal.

Camus' ethics, like that of the Existentialists, will not bow to transcendent and preexisting values, which have become outworn or effete today and which impress many moderns with the conviction that, in the words of Meredith's *Modern Love,* "We are betrayed by what is false within." Man must create his own values, as he forges ahead, and thus recover his own center.[3] The task is anguishing. But "there is something beyond anguish, and it is not a Christian solution. It is revolt" (*Noces*). Through revolt, the anti-Christian moralist may spurn the pessimism inherent, according to Camus, in Christianity and emerge from nihilism. Through it also, he learns, with Camus' mouthpiece in *The Plague,* that "there are in man more things to be admired than to be scorned." The problem for man today is how to live without grace and yet how to accept one's unlimited responsibilities. French critics like to distinguish between the literature of happiness, which has become rare in our age, and the literature of salvation. Camus had proclaimed, in *Noces,* the right to happiness. But Rambert, the journalist who will at first flee the beleaguered pestilential city to join his mistress, later decides to stay and fight the evil. "There is shame in being happy all alone," he avows. To be a saint without God is the ideal proposed to himself, with modesty, by the narrator in *The Plague.* That narrator combats the disease with medical means. The artist, for Camus, likewise strives to decrease the misery of the world. "He practises a profession which, in the midst of a world withered by hate, enables him to say in all peace of mind that he is no man's mortal enemy." He preserves the rights of dialogue in an age of ideologies. "He is on the side of life, not of death," while the conquerors of all kinds around him want a world of masters and slaves. No nobler statement of the meaningfulness of art in our time has been formulated than the essay placed at the end of *Actuelles I* and printed in English in *Commentary* in December, 1949: "The Artist as Witness of Freedom."

The originality of the anti-Christian thinkers in France at the present time is that they are equally remote from the materialism which, a century ago, attacked religion on scientific grounds and from the anti-clericalism which, not without childish narrow-mindedness, denounced religion only at its worst and sapped its intrusion into politics. It is hardly concerned with exegesis or with comparative religion; it wastes little time in arguing that God does not exist. It has been called "antitheism" rather than "atheism," for it asserts that, if God is eliminated, a higher ethics may be possible for man. Christianity is challenged in its very ethics, and by men who appear to have a burning sincerity which the apologists of orthodox faith envy them and a sense of the tragedy of man's fate of which too many Christians, seeking for peace of mind and for the fallacious "power of positive thinking" in their creed, are devoid. Camus, along with Malraux and before him Elie Faure, with Saint-Exupéry and with many a French poet of today intoxicated with God's absence, is thus the true inheritor to Pascalian tragic sensibility.

Far from polemizing against those negators, several of the most authoritative members of the Church or defenders of Christian faith in France have lately hailed those unbelievers in whom they acknowledge allies in disguise. The statement of one of the most passionate apologists for early Christianity, another North African, Tertullian, again holds true: "Oportet haereses esse, . . . et plurimum valere." It is greatly to the credit of Roman Catholic thinking in France today that it has equalled, in breadth of mind and in unflinching reexamination of its own creed, the intelligent antitheism of its traditional opponents. A Jesuit father, writing in America in *Thought,* quoted by another Jesuit, Walter J. Ong, in *Frontiers in American Catholicism* (Macmillan, 1957), contended that this is probably the most profound Catholic century of French history. Instead of upholding religion as an ideal of service for op-

[3] The lines from "The Second Coming," in *Michael Robartes* by Yeats have become one of the favorite quotations of our moralists:

> Things fall apart; the center cannot hold; . . .
> The best lack all conviction, while the worst
> Are full of passionate intensity.

timistic and "positively minded" business men, as a pretext for recreational activities and for social life and athletics tinged with a faintly Catholic hue, French Catholics have evolved new philosophical interpretations of history (Massignon, Puech, Marrou), of theology (Gilson, Maritain), of science (Leprince-Ringuet, Teilhard de Chardin), of the social duties of the middle class and of labor relations (the worker-priests), of liturgy and of sacred art. Since Péguy, Claudel, Jammes, Bernanos, Roman Catholic literature has been flourishing as it had not done since the Middle Ages. The prestige of Catholic thought and art in France has spread to Switzerland and Germany, to Great Britain where Graham Greene, Evelyn Waugh, Edith Sitwell, and many other converts among men of letters have looked across the Channel for direction, to American Catholicism in its intellectual spheres.

In the Catholic periodical *Esprit,* which has exercised a profound influence upon the liberals among the church-goers in France and even upon the politics of the M. R. P. (Mouvement Républicain Populaire), Jean Lacroix assessed, in February, 1954, the value of present-day atheism. He welcomed the task of purification of religion to which the foes of Christianity periodically invite the Christians. Maritain, recalls Jean Lacroix, considered that the saint is an integral atheist as regards the false gods who are too often revered inside religion itself: materialism, greed, money, naturalism, nationalism; he welcomed atheism inasmuch as it denounces the large share of superstition which lurks in religion. He even had hailed, in *L'Humanisme intégral* (1936) Marxism as "marked with the supernatural sign of the great motions of God's sword in history," for it had opened the eyes and the hearts of many hitherto complacent Christians to the scandal of the alienation of the proletariat, and hence to its progressive dechristianization. Jean Lacroix added, speaking in his own name which is a respected one among French Catholics, that atheism can be to a large extent a purification of religion and a rejection of the false gods, which the believer can then turn to the glory of the true One. "Too often these days it is atheism which has become a commitment of the whole being, and theism an opinion of good society, a vague, unefficacious opinion." One of the leading Jesuit writers of our age, Father Henri de Lubac, studying Feuerbach, Proudhon, Nietzsche and their followers in *Le Drame de l'humanisme athée* (1945), translated as *The Drama of Atheistic Humanism* (Sheed and Ward, 1949), began by acknowledging that those negators are "more Christian at times than those who fight against them; often also they prove more clear-sighted interpreters of history." That atheistic humanism was and is neither coarsely hedonistic nor materialistic. "Man eliminates God in order to recover human greatness which he sees as unfairly taken over by another being."

A similar tone of gratitude toward the thinkers, writers, and artists who challenged traditional religion and proclaimed their own humanism as a liberation from God is heard in several of the religious writers who, from Paul Claudel to Father Le Couturier, both now deceased, have lamented the decadence of sacred art. They have been struck by the paradox that the extraordinary revival of sacred art in architecture, sculpture, frescoes and paintings, church and liturgical objects, missals, has been achieved in large majority by artists who were not Christians or failed to subscribe to Christian faith: Le Corbusier, Braque, Léger, Matisse, Picasso, Chagall, Germaine Richier; Rouault was the single exception among them. Among those non-Christian artists, the Dominican priest who has written most extensively on the subject, Father P. R. Régamey acknowledged in *Art sacré au XX^e siècle* (Editions du Cerf, 1952) "simple substitutes for faith may prove to be more efficacious than the supernatural faith of another artist." Those humanists often tap deeper spiritual sources of religion than do the church-goers; in an age when the sense of the sacred is dimmed in many so-called believers, they have sought for other examples of the sacred in art among primitives, masks and statues revealed to them by anthropologists and archaeologists. The vision of a Picasso suddenly enabled us to read into those primitive objects what our predecessors had long failed to perceive in them; a great artist or a writer with a new keenness of vision thus, in Proust's metaphor, removes a spiritual cataract from the many among us who have eyes but do not see. "The spiritual potentialities latent in unbelieving artists" as Father Régamey terms them in their turn inspire other practitioners of sacred art, such as the authentically Christian painters Bazaine and Manessier in France today.

There may well be more unity than meets the eye of the foreign observer behind the apparent disunity and turmoil of France and her culture.

Jean Cocteau is fond of saying that disorder allows France to live, just as order seems indispensable to other countries. Polemics thrives among believers and negators, nihilists and positivists. But Camus was not merely attempting to allay American distrust of Existentialist passionate unbelief when, in the June, 1953, *Atlantic Monthly*, he gravely declared: "In the lower depths of our nihilism, I have searched only for reasons to transcend it." His revolt against transcendence has always aimed at serving, and ennobling, man. His challenge of the ethical teaching, and of the ethical practice of Christianity, prone to too many compromises, has in truth helped Christianity in France look more lucidly into its own failures. In that sense, he is one of those agnostics praised by Nietzsche in a well-known passage in *The Dawn of Day* (Aphorism 192):

> It cannot be denied that the French have been the most Christian nation in the world, not because the devotion of the masses in France has been greater than elsewhere, but because those Christian ideals which are most difficult to live up to have been incarnated there. . . . The French unbelievers always had to fight against truly great men, not, like the freethinkers of other nations, merely against dogmas and sublime abortions.

THE CONTROLLED RULING OF DIFFRACTION GRATINGS

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(*Read April 24, 1958*)

I. THE DIFFRACTION GRATING AND ITS BACKGROUND

THE diffraction grating, heart of the modern spectrograph, has been called by a great astronomer "The master key of science." A grating, dispersing into an orderly array according to wave length the constituent parts of any beam of light that may fall upon it, can reveal much about the atoms and molecules which have emitted the light, whether these be on earth or in the heavens. Any large modern telescope has one or more attendant spectrographs, and the physicist, the chemist, the metallurgist, and the biologist as well, have all found use of the grating indispensable on occasion.

For more than a century the problem of engraving gratings of improved quality and ever larger size has presented one of the great challenges of precise instrumentation. Though the problem is difficult to solve, it is simple to state. On a polished mirror of high optical quality we wish to engrave many thousands of shallow grooves, whose sides will act as mirrors, each several inches in length, all to be straight, parallel, and equidistant. These grooves will diffract into beams any light that may fall on them, and these beams will, by interfering with each other, produce a spectrum whose purity will improve as the regularity in placement of the grooves across the beam is increased. To produce spectra of the purity desired the grooves should be both straight and parallel to within a millionth of an inch. Although the exact spacing between grooves has little effect on purity, once selected this spacing must be reproduced even more closely—regularity to one-tenth of a micro-inch is desirable. Furthermore, any errors in groove positioning of more than this amount must not form a periodic pattern, for such regularities will produce false lines in the spectrum called ghosts, which complicate its interpretation. Nor can any accumulation of error in the location of the grooves greater than a micro-inch be tolerated without loss in quality. If, for example, 120,000 grooves are engraved on a mirror 8 inches wide, the 120,000th groove must be within a millionth of an inch of its proper position relative to the first groove, as well as to all the others, though the grating may have required a week or more for its engraving.

Always the desires of the would-be improver of gratings have exceeded his accomplishment. The perfection of control needed seems not unattainable, but in the range of precision where millionths of an inch loom large the strongest metals behave like rubber, and an undependable sort of rubber at best.

Figure 1 shows a model of a diamond tool poised above a model mirror, in the process of ruling a groove. Since each groove is to be a long sliver of mirror, each part of every groove engraved must be shiny and of similar orientation throughout the grating. No metal is removed in the engraving, the groove being pressed into the soft aluminum coating of the mirror by the sharpened edge of the diamond tool.

It is a common misapprehension that closeness of grooves is an evidence of superiority, or at least of difficulty of manufacture, in a grating. Ruling 30,000 grooves to the inch takes longer than ruling 5,000, to be sure, but as many as 100,000 grooves to the inch have been ruled on

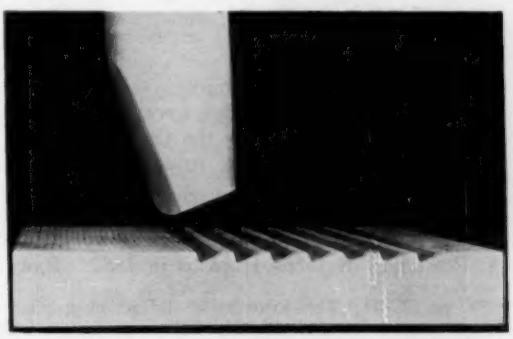

FIG. 1. Model of an aluminum-coated mirror with a diamond tool engraving grooves on its surface, as in the ruling of diffraction gratings. The grooves are here magnified approximately two thousand times, while the diamond is about ten times normal size.

inferior engraving engines. The principal difficulties in ruling a grating arise not so much because of the closeness of the grooves needed, as from the precision required in their location. The ability of a grating of good quality to separate precisely and well the wave lengths of light falling upon it depends only on its over-all ruled width and the angles at which light is sent to it and from it.

II. RULING ENGINES FOR ENGRAVING GRATINGS

The principal advances in grating ruling have been made by such well-known scientists as H. A. Rowland, R. W. Wood, and John Strong of Johns Hopkins, A. A. Michelson and H. G. Gale of Chicago, Manne Siegbahn of Stockholm, and J. A. Anderson and H. D. Babcock of Mount Wilson Observatory. Important contributions have also been made, however, by talented amateurs who had enthusiasm for attacking challenging mechanical problems. L. M. Rutherfurd, a New York lawyer interested in astronomy as a hobby, and Lord Blythswood of England, spent many years working on ruling engines in the last century, and H. J. Grayson, a nurseryman of Melbourne, built an engine with which he ruled the most closely-packed lines ever engraved.

The original inventor of the diffraction grating was in all probability David Rittenhouse of Philadelphia,[1] who in 1785 spaced 53 slits uniformly in an aperture one-half inch wide, with which he produced a rather impure but real spectrum. In 1823 J. Fraunhofer,[2] who is usually credited with the invention of the grating, produced one having 4,000 grooves in a width of one-half inch, while in 1846 another German, named Obert, succeeded in ruling 6,000 grooves on mirrors one inch wide. Since all these early gratings were less effective dispersers of light than were the glass prisms then readily available, they were principally of theoretical interest.

The great step forward which resulted in the modern diffraction grating was made by Henry A. Rowland[3] of Johns Hopkins in 1882. Rowland, then the leading American physicist, is said to have been led into grating research by stubbornness and pride. While presiding over the discussion at a physics colloquium at which one of his colleagues had spoken on diffraction gratings and on the difficulties of their production, Rowland stated his belief that the problem was not really very difficult (a pronouncement made by many lesser scientists and inventors since Rowland's day). He was promptly challenged by the speaker to produce a good grating himself, and with characteristic vigor replied that he would look into the matter. After pondering the problem, Rowland decided that the main difficulty lay in producing a sufficiently perfect screw, which, on being rotated repeatedly through a small uniform angle between strokes, would always advance the mirror under the ruling diamond by the same amount. He decided that a satisfactory screw could never be cut on a lathe, but that one containing the inevitable minute irregularities could be smoothed out as much as needed by lapping it carefully with a long nut split along its length into several parts, which could periodically be rearranged in position on the screw.[4]

Within two years Rowland had an engine with which he could produce gratings nearly six inches wide, of a quality far superior to any previously ruled. During the remaining nineteen years of his life he built two additional engines, and for several decades his three machines produced most of the world's supply of diffraction gratings. Figure 2 shows a famous photograph of Rowland leaning over one of his ruling machines, usually referred to as an engine to preserve a pleasant air of antiquity.

With the gratings he produced Rowland did much important work in spectroscopy, and an interesting bit of serendipity emerged from his ruling experiments. Through an ingenious combination of theory and experiment he invented the concave reflection grating, which did away with the necessity of using lenses or mirrors in a spectroscope, and thus made attainable new sections of the infrared and ultraviolet regions. The "Rowland mounting" of the concave grating, and the "Rowland circle" which represents its focus, commemorate him. His name is also perpetuated in the "Rowland ghosts," special types of false

[1] Cope, T. D., The Rittenhouse diffraction grating, *Jour. Franklin Inst.* **214**: 99–104, 1932.

[2] Fraunhofer, J., Kürzer Bericht von den Resultaten Neuere Versuche uber die Gesetze des Lichtes und die Theorie Derselben, *Ann. der Physik* **74**: 337–378, 1823.

[3] Rowland, H. A., Preliminary notice of the results accomplished in the manufacture and theory of gratings for optical purposes, *Phil. Mag.* **13**: 469–474, 1882; Preliminary notice of the results accomplished in the manufacture and theory of gratings for optical purposes, *Nature* **26**: 211–213, 1882; On concave gratings for optical purposes, *Phil. Mag.* **16**: 197–210, 1883.

[4] Rowland, H. A., Article Diffraction gratings, *Encyc. Britannica*, 458–459, 1902.

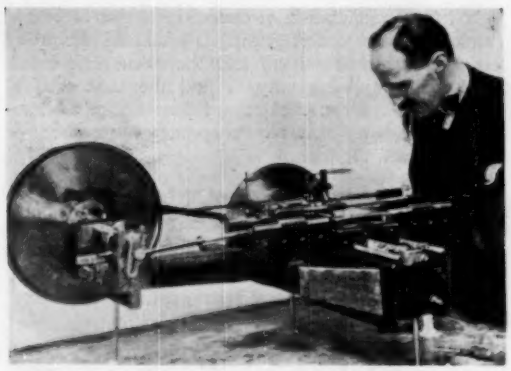

FIG. 2. Professor Henry A. Rowland of Johns Hopkins University, with one of his ruling engines.

lines found in the spectra of gratings ruled with screws whose threads contain periodic errors.

All ruling engines since Rowland's day have to some extent been based on his original mechanical design.[5] After his death in 1901 his machines were kept in operation until the great Baltimore fire of 1904, at which time they were badly damaged, first by water and then by amateur attempts at repair. In 1909 Dr. J. A. Anderson put them into good condition, and with them ruled many 6-inch concave gratings of outstanding quality.[6]

In 1916 Anderson was called to the Mount Wilson Observatory, where he made many important contributions to the art and science of grating ruling. He supervised the completion of a ruling engine designed to produce gratings up to 20 inches in width which, although it did not fulfill its original purpose, produced some useful 6-inch gratings. His ruling engine work was continued in a new direction in 1930 by Harold D. Babcock, who began the construction of the present 10-inch Mount Wilson engine. With this, Babcock and his son, Dr. Horace W. Babcock, in the past twenty years have produced many outstanding gratings, including some of 8-inch ruled width which attained new heights of performance.[7]

In the meantime, back at Hopkins, Rowland's ruling engines languished for a time after Anderson's departure, until in 1923 R. W. Wood refurbished them and put them again into operation. Though always unpredictable, Wood was an experimental genius. He told me once that the president of the University had issued specific orders that R. W. Wood was under no circumstances to be allowed to touch Rowland's engines. However, Wood fortunately got his hands on them, and with great glee began the production of a long series of outstanding 6-inch concave gratings which formed the world's main supply for many years.[8]

After Wood's retirement, his successor, Dr. John Strong, designed and built a new type of ruling engine, introducing features which eliminated some of the weaknesses of Rowland's original design.[9] Strong decided to engrave the grooves by pulling the mirror sideways under a diamond which was advanced intermittently by the screw, a method which automatically keeps the grooves parallel. By this means, as well as with Rowland's engines, Strong has ruled many excellent 6-inch gratings.

A third great American school of grating ruling was founded by Albert A. Michelson at the University of Chicago a year before Rowland died. In 1900 Michelson began the construction of an engine designed to rule gratings up to 14 inches in width, and by 1906 this engine was producing small gratings of fair quality. By 1915 Michelson had succeeded in ruling a grating 9.3 inches wide.[10] With understandable pride he took this to a dinner being held in his honor, for exhibition. Unfortunately, when he rose to speak the grating dropped from its unlatched box to the floor, and broke into a hundred pieces. One of these, given me by a student present at the dinner, I hold as a cherished relic. The quality of the grating was only fair by modern standards, partly because gratings were then ruled on polished speculum mirrors, whose hard crystalline surface blunted the edge of the ruling diamond much more rapidly

[5] Harrison, G. R., The production of diffraction gratings. I. Development of the ruling art, *Jour. Opt. Soc. Amer.* **39**: 413–426, 1949.

[6] Anderson, J. A., Periodic errors in ruling machines, *Jour. Opt. Soc. Amer.* **6**: 434–442, 1922; *Glazebrook's dictionary of applied physics* **30**.

[7] Babcock, H. D., Bright diffraction gratings, *Jour. Opt. Soc. Amer.* **34**: 1–5, 1944; Babcock, H. D., and H. W. Babcock, The ruling of diffraction gratings at Mt. Wilson Observatory, *Jour. Opt. Soc. Amer.* **41**: 776, 1951; Pierce, A. K., Performance of an eight-inch Babcock grating in a large vacuum spectrograph, *Jour. Opt. Soc. Amer.* **47**: 6–14, 1957.

[8] Wood, R. W., Improved diffraction gratings and replicas, *Jour. Opt. Soc. Amer.* **34**: 509–516, 1944.

[9] Strong, J., New Johns Hopkins ruling engine, *Jour. Opt. Soc. Amer.* **41**: 3–15, 1951.

[10] Michelson, A. A., The ruling and performance of a ten-inch diffraction grating, *Proc. Amer. Philos. Soc.* **54**: 137–142, 1915; The ruling and performance of a ten-inch diffraction grating, *Jour. Franklin Inst.* **181**: 785–789, 1916.

than does the soft aluminum coating on glass used today. Later Michelson succeeded in ruling a second grating of the same size, but the thin speculum blank gradually lost its optical figure, and the grating became a museum piece, though this time a single one.

Like most experimenters with ruling engines, after several years of experience Michelson felt that he could do better if he started again, so he began the construction of a second engine. In the 1930's further rebuilding of his two engines at Chicago was undertaken by Professor Henry G. Gale.[11] With one of these Gale ruled half a dozen fairly good 6-inch concave gratings, but at the time of his death Gale was again re-designing both engines. Soon after World War II began, all work on them was stopped. At the end of the war, one of these engines was presented to the Bausch & Lomb Optical Company, who after modifying it somewhat have operated it so efficiently as to become the world's principal present supplier of commercial gratings.

European contributions to the ruling of diffraction gratings have been somewhat sporadic. At the National Physical Laboratories in Teddington, England, Lord Blythswood's engine ruled several hundred small gratings between the two world wars.[12] Dr. Manne Siegbahn has produced many excellent 4-inch gratings with his engine at the Nobel Institute in Stockholm.[13] At the 1958 Brussels Fair a number of gratings were on display in the Soviet exhibit, and the ability of the Russians to supply gratings up to 6 inches in ruled width was advertised. These gratings apparently are of about the quality of the commercial gratings available before Bausch & Lomb got the Chicago engine into operation. Russian scientists are apparently making rapid progress in the techniques of ruling, however, and can be expected to produce interesting results in the next few years.

The difficulties of ruling gratings of high quality in widths greater than 8 inches with a mechanical engine appear extremely great. As Michelson writes,[14]

> When the accumulation of difficulties seems to be insurmountable, a perfect grating is produced, the problem is considered solved, and the event celebrated with much rejoicing only to find the next trial a failure. . . . One comes to regard the machine as having a personality . . . requiring humoring, coaxing, cajoling, even threatening!

The "perfect" grating to which Michelson refers, like those of Rowland and every follower since, showed many defects with which we would now be dissatisfied. Gradually quality requirements have been increased as gratings of better quality became available. Figure 3 illustrates the importance to the spectroscopist of increased resolution of close-lying lines. Obtaining the mechanical stability needed in an engine to rule a grating of the size and quality needed to separate the closest lines in such patterns requires seemingly impossible avoidance of warpage, wear, creep, corrosion, and elastic deformation. In 1948 we therefore decided to experiment in the Spectroscopy Laboratory at M.I.T. on controlling an engine by means of light waves, using these to locate and to maneuver the relative positions of the diamond and the grating being ruled. By using photoelectric control through servomechanisms, we hoped to enable the engine to rectify its own errors automatically before these could be-

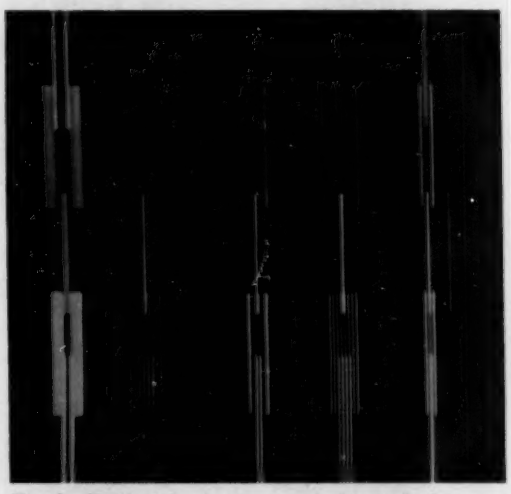

FIG. 3. Portion of a spectrogram used to study the structure of the rhodium atom. Although the individual Zeeman patterns of many of the lines are clearly resolved, the power of the grating used was not sufficient to separate all the important lines, especially those in patterns on the left.

[11] Gale, H. G., The design of machines for ruling of diffraction gratings, *Jour. Sci. Inst.* **12**: 32, 1935.

[12] Scoble, W. A., The Blythswood dividing engine for ruling diffraction gratings, *Collected Researches, Nat. Phys. Lab.* **8**: 213–251, 1912.

[13] Siegbahn, M., and T. Magnusson, Zür Spektroskopie der ultraweichen Röntgenstrahlung. I. *Zeits. f. Physik* **62**: 435–456, 1930; *ibid.* IV. **95**: 133–157, 1935.

[14] Michelson, A. A., Recent progress in spectroscopic methods, *Nature* **88**: 362–365, 1912.

come large enough to interfere with the desired precision of ruling. We have now succeeded in developing methods of control which do this to a considerable degree.

III. PHOTOELECTRIC CONTROL OF GRATING RULING

Michelson's first engine, about half complete in its third incarnation, was presented by the University of Chicago to the Massachusetts Institute of Technology in 1948. Unfortunately, the great screw of this engine, 3.5 inches in diameter and with 20 inches of carefully lapped thread, had warped by about 1/10,000 of an inch during its wartime storage. This was sufficient to introduce several periodic errors into the spacing of gratings ruled with the screw, some of which were more than a hundred times the tolerable limit. Here, it appeared, was a good opportunity to see whether control with light waves and servomechanisms could overcome marked mechanical deficiencies in an engine.

The necessary optical, electrical, and mechanical parts were soon assembled, but for the first seven years even the smallest grating ruled on this engine was wretchedly low in quality. Careful electronic tests indicated that the control system was operating well. Ultimately we discovered that a minute twisting motion of the mirror as it was slowly moved by the engine under the diamond was causing the difficulty. Although the electronic system was indeed controlling the front of the mirror properly, that part of the mirror on which the diamond was ruling a groove was not where it belonged. When this defect was rectified, 8-inch gratings of excellent quality were produced. Additional improvements have resulted in 10-inch gratings with fewer and smaller defects than the gratings hitherto available, and it appears possible to rule still larger gratings by the new means.

After various methods of photoelectric control had been tried the engine gradually evolved into the form shown in figure 4.[15] A large mirror mounted on a carriage carrying the mirror to be ruled serves as part of a Michelson interferometer, which locates the position of the grating blank very precisely in terms of interference fringes. A shift of one fringe indicates a translation of the mirror through about ten millionths of an inch, and the apparatus responds to a hundredth of a fringe or less. More than a million fringes, at the rate of about three per second, pass across the face of a photoelectric cell during the ruling of a large grating, measuring off the slow progress of the mirror under the diamond as it moves its allotted 10 inches in about five days, while the diamond presses out its many miles of tiny furrows. A photocell produces from the moving fringes a sinusoidal electrical signal, which is amplified and compared in phase to a similar signal produced by the motion of the diamond, ruling at right angles to the motion of the mirror. These two wavetrains remain matched in strength and period, but the phase relation of their oscillations is shifted whenever an error occurs in the position of blank relative to diamond. Any such shift actuates a motor which turns in the direction needed to eliminate the phase discrepancy.

By such means it is possible to observe on the screen of an oscilloscope errors in the position of the mirror being ruled as small as one ten-millionth of an inch. Small mechanical errors of various kinds creep in, but these are found to reduce the quality of the gratings but little.

Figure 5 shows the degree to which the fringes can be made to control the groove spacing. Straight horizontal bands in this interferogram[16] of light diffracted from a grating indicate uniformity. The bands from parts of the grating ruled while light waves are in control are straight,

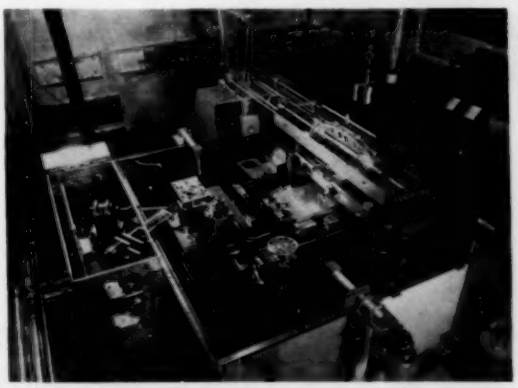

FIG. 4. View of the interferometrically controlled ruling engine, with the oil removed from its containing vat.

[15] Harrison, G. R., and J. E. Archer, Interferometric calibration of precision screws and control of ruling engines, *Jour. Opt. Soc. Amer.* **41**: 495–503, 1951; Harrison, G. R., and G. W. Stroke, Interferometric control of grating ruling with continuous carriage advance, *Jour. Opt. Soc. Amer.* **45**: 112–121, 1955.

[16] Stroke, G. W., Interferometric measurement of wave front aberrations in gratings and echelles, *Jour. Opt. Soc. Amer.* **45**: 30–36, 1955.

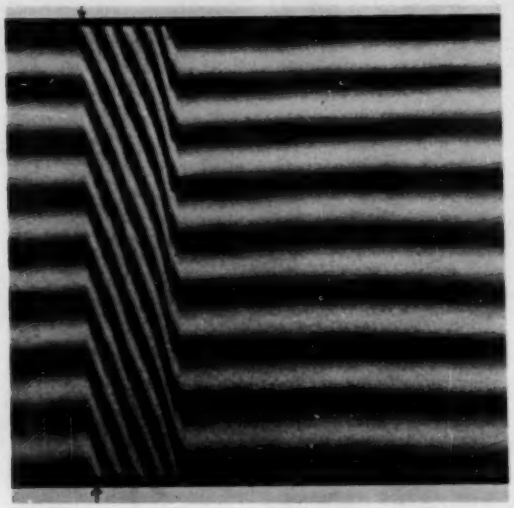

FIG. 5. Interferometer test of the flatness of the wave front from a grating, which can reveal errors in groove position smaller than one-tenth of a millionth of an inch. Over the section in which light waves were in control of the engine the bands are horizontal and uniform, but when the light control was turned off (at the point marked by arrows), errors in groove positioning began to accumulate, as shown by the steeply inclined bands. When control was restored the grooves were again spaced uniformly.

but when the controlling light is shut off, the steep inclination of the bands shows a rapidly accumulating error in positioning of the grooves by the unaided screw. When control is restored, the bands again become straight and horizontal.

To eliminate the "micro-twisting" of the mirror carriage which caused our first sixty gratings to be worthless,[17] a second large Michelson interferometer was added to the engine. This produces a third wave train, which can be compared with that used to control the grating translation, and thus determine any minute rotation of the mirror as it is ruled. Any shift in phase of this signal relative to the others is fed to a servo which immediately rotates the mirror back to its original orientation. The servomechanism developed is found to be sensitive enough to detect rotation of the blank through 1/500 of a second of arc. Thus the mirror is made essentially to move in a straight line on a crooked track.

[17] Harrison, G. R., N. Sturgis, S. C. Baker, and G. W. Stroke, Ruling of large diffraction gratings with interferometric control, *Jour. Opt. Soc. Amer.* **47**: 15–22, 1957.

IV. GRATING QUALITY, GHOSTS, AND SATELLITES

No perfect diffraction grating has ever been ruled, and the nature of the residual defects is important. In good gratings one usually looks first for high resolving power, the ability of the grating to separate close-lying spectrum lines, as shown in figure 3, and then at the intensities of ghosts and satellites, of which typical examples are shown in figure 6.

Of the one-hundred gratings ruled thus far in our program, the most recent include eight of 8-inch width, and six slightly wider than 10 inches. Most show practically theoretical resolving power in all orders for visible light, with values up to 900,000 in the green (compared to 700,000 for the best grating previously cited in the literature) and up to 1,500,000 in the ultraviolet. These gratings are thus as powerful as interferometers which are much more difficult to adjust and to use.

Figure 7 shows spectral line patterns produced by grating No. 97 having 7,500 grooves per inch, which gives information on the isotope and nuclear structures of the emitting atoms.

Since the new gratings are ruled on rectangular blanks to reduce weight, the 10-inch size corresponds to what would ordinarily be called an 11.2-inch grating. Fifty square inches of ruled area are active, as compared with the fourteen or so of the standard grating. With such a large grating blazed to throw nearly three-fourths of the light falling on it into one high order, the time required to photograph the spectrum of a faint star, nebula, or terrestrial source can be greatly reduced.

Rowland ghosts are ordinarily considered negligible if they are less than 1/1000 as intense as the lines of which they are luminous echoes. The ghost intensities are usually measured at a low

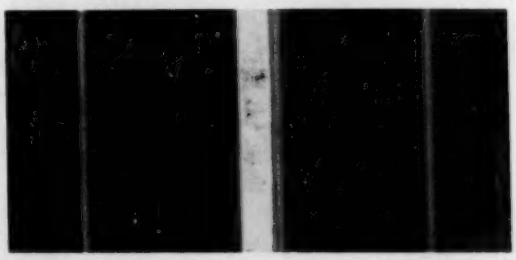

FIG. 6. An overexposed spectrum line, with typical Rowland ghosts to the right and left, and satellites close by on the right.

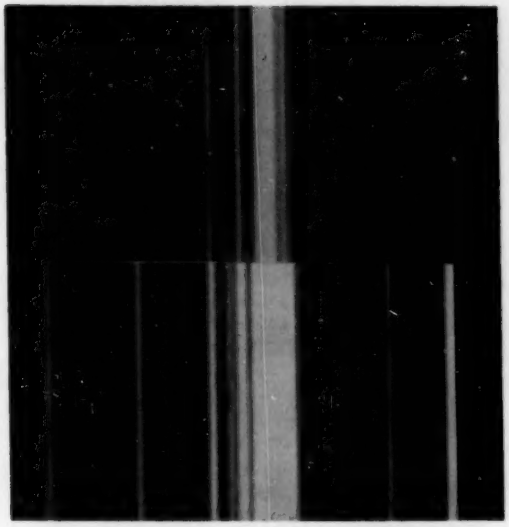

FIG. 7. Two exposures showing hyperfine structure of line 4358 Å. as emitted by the mercury atom, showing high resolution produced by a 10-inch grating.

angle of illumination, however, are much greater at higher angles. In recent years the need of spectroscopists for gratings of higher power has made more important the use of gratings at these angles, where the ghost intensity may increase thirty-six-fold. To reduce the ghosts at high-angles to 1/1000 of the intensity of their parent lines, it is therefore necessary to reduce those in the first order to below 1/36,000. Several of the 10-inch gratings ruled on the controlled engine show ghosts less than one-third as strong as this. However, the Rowland ghosts have not yet been completely laid, for their intensity also increases when light of shorter wave lengths is used, and they are especially objectionable in the vacuum ultraviolet. We hope, therefore, to be able to reduce them still further. This can probably be done by applying control to a more perfect screw than the one in our engine, in which the servomechanisms fail to remove the last 1/1000 of the periodic error.

Satellites can be seen in vast numbers around the strong lines produced by nearly all gratings if sufficient exposure is given, and these may interfere greatly with the study of weak lines in a complex spectrum. They can be suppressed by underexposure, as shown in figure 8, and many an apparently good grating of the past has failed when an appropriate satellite test was given later.

We found the satellites from our gratings to be greatly reduced when the rotation control was added to the engine, but traces remained. They were found to originate from a slight up-and-down motion of the mirror during ruling, and were reduced by a factor of ten by improving the geometry of the control interferometers. The most recent gratings are almost free of satellites, and it is believed that they can be eliminated by improved temperature control.

If the temperature of the mirror changes for a time while it is being ruled the resulting grating will show satellites, and for this and other reasons it is necessary to keep the engine temperature constant to within 0.01° F. or better. It is therefore mounted in a vat with its lower parts immersed in a thermostated bath of oil.

Because variations in atmospheric pressure affect the lengths of the light waves used to control

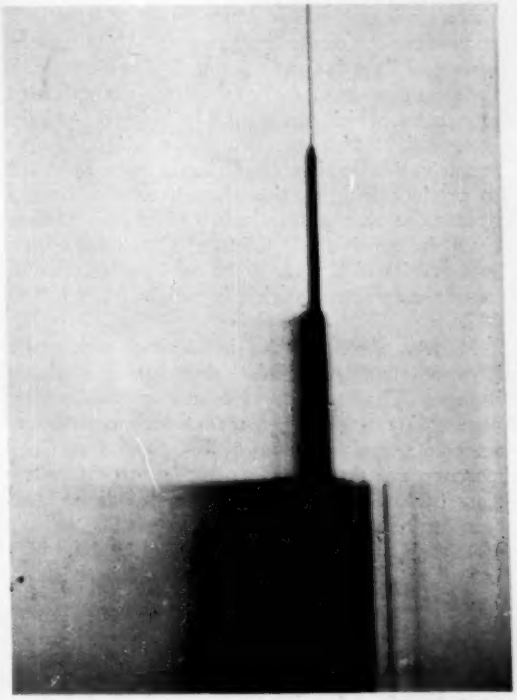

FIG. 8. A spectrum line produced by a faulty grating, which appears sharp and narrow in a short exposure, but widens as the exposure is increased, until it shows many satellites. Since it is often necessary to overexpose strong lines in order to measure faint ones, production of such satellites by a grating greatly limits its quality.

the engine, it would be desirable also to keep the air around it at constant barometric pressure. This is difficult, however, and instead a servomechanism is used to compensate for the fringe shifts produced by air pressure changes.[18]

V. LIMITATIONS AND PLANS

The maximum width of grating that can be ruled with a mechanical engine is usually limited by the accumulation of errors in the position of the mirror being ruled. In the controlled engine the limitation is set, instead, by the extent and the stability of the interference field that can be maintained precisely located in space during the time necessary to rule the grating. A further theoretical limitation lies in the length of the optical interference path which can be set up and clearly defined. This length depends not only on the precision of optical parts used in the control of interferometers and on their adjustment, but also on the wave-length spread of the beam of light used to produce the controlling fringes. A most useful source of light for engine control, for example, is the strong green mercury line at wave length 5461 angstroms, which can readily be isolated from the intense light of a mercury vapor lamp. Unfortunately, this line is not sufficiently monochromatic to produce fringes crisp enough to give control over more than a few inches of engine motion, since it consists of thirteen close-lying lines, groups of which come from various isotopes of the mercury atom ranging in weight from 198 to 202.

Modern developments in nuclear technology have now made available mercury of a single isotope. Thus mercury 198 can be obtained by bombarding gold with neutrons in a nuclear reactor to transform some of the gold atoms into mercury, and then distilling this into an evacuated glass tube. Lamps made by this technique have been very successfully developed by Dr. W. F. Meggers at the National Bureau of Standards,[19] and all of our gratings thus far have been ruled under the control of light waves from Meggers lamps.

Although the concave grating, as developed by Rowland, is still in wide demand for use in spectrographs, when illuminated at the high angles needed for much of modern spectroscopy it suffers from the defect of astigmatism. For this reason plane gratings are coming into increasing use in spectroscopic research, especially since bright aluminum-coated concave mirrors have become available for use with them.

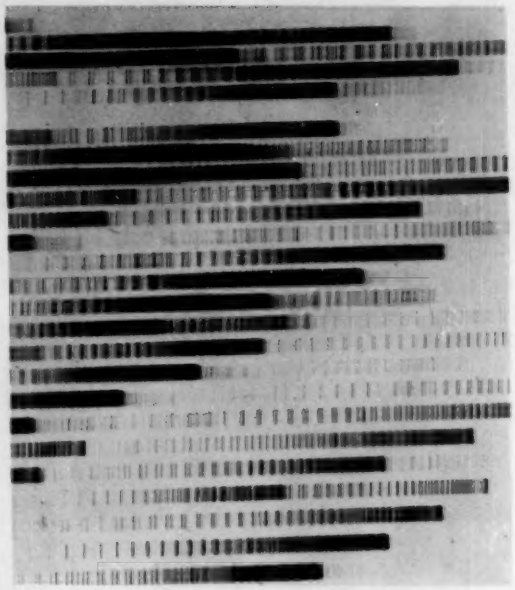

FIG. 9. Typical band spectra photographed with an echelle crossed with a concave diffraction grating.

As it becomes possible to use the plane grating at increasingly steep angles of illumination, there is also a trend toward use of wider groove separations. The resolving power obtainable with a grating of 1,000 grooves per inch may, in fact, be greater than that obtained with one of 30,000 grooves to the inch, because of the greater perfection of the grooves and the smaller amount of diamond wear that occurs in ruling a given width of grating. We have recently found it useful to cross with a concave grating of the usual type a coarse though precisely formed grating having 200 to 2,000 grooves per inch, called an echelle. Such a spectrograph produces cyclic spectra as shown in figure 9, and compresses a spectrum which previously required twelve 20-inch long photographic plates for its recording onto one 20-inch plate. Echelle spectrographs can be made to combine the high-power and dispersion of a large grating spectrograph with the compactness, high photographic speed, and other advantages of a small one. With the controlled engine it be-

[18] Harrison, G. R., and J. E. Archer, Interferometric calibration of precision screws and control of ruling engines, *Jour. Opt. Soc. Amer.* **41**: 502, 1951.

[19] Meggers, W. F., and F. O. Westfall, Lamps and wavelengths of mercury 198. *Jour. Research Natl. Bur. Stds.* **44**: 447–455, 1950.

comes possible to rule echelles satisfactory for use in such spectrographs.

Controlling the engine with light from individual isotopes theoretically makes possible the ruling of gratings several feet in width, but controlling an engine of such size and weight is like teaching an elephant to dance. However, the control method may well make it possible to rule the two halves of a large grating simultaneously with two diamonds.

A further advantage of interferometric control is that gratings with variable groove spacings can be ruled, not only for analysis of the defects produced by various types of spacing errors, but for the production of gratings for special purposes. Thus in an echelle it is theoretically possible to offset certain mirror defects by properly curving the grooves along their lengths, and by spacing them non-uniformly.

Two serious drawbacks that have been ascribed to the controlled ruling engine are the complexity of its electronic and optical components, and the fact that its operation must at present be periodically inspected. Since no mechanical engine has thus far produced gratings of the large size and high quality obtained when control is used, these objections seem academic. In point of fact, assembly of the needed optical and electronic systems is found to be much simpler than the attainment of the perfection needed in a purely mechanical engine of much smaller size.

VI. SUMMARY

By using light waves to control a diamond tool while it engraves grooves on an aluminum-coated mirror to produce a diffraction grating, the quality of the resulting grating can be improved and, if desired, its size increased. Half a dozen gratings of high quality ten inches in ruled width have been produced on such an engine. The resolving power of several of these gratings is found to equal that theoretically expected, in all orders up to and including the highest obtainable with visible light. Resolving powers of 900,000 in the visible and 1.5 million in the ultraviolet have been measured.

Rowland ghosts, while not completely eliminated, have by the use of servomechanisms been reduced to well below a tenth of 1 per cent at the highest angles. A typical value is 1/3300 in the 11th order green of a 7,500 groove per inch grating, which corresponds to less than 1/100 fringe of periodic error in a screw known to contain 8 fringes. Thus all but 0.1 per cent of the error of the screw is removed. Satellites have also been reduced to negligible values.

The new gratings are extremely efficient, concentrating nearly three-fourths of green light in one desired order from the entire 50 square inches of the grating face.

It has thus been found possible, by using interferometric control of a ruling engine of far from perfect mechanical quality, to improve the size, quality, and speed of diffraction gratings.

Many students and colleagues have contributed to various parts of this project. This help has been acknowledged in the papers giving technical details,[15-17] but I wish especially to mention the outstanding contributions of James E. Archer, William Culver, George W. Stroke, and Neville Sturgis. The project was made possible by the gift from the University of Chicago of the basic mechanical parts of the engine, and by the continuous interest and support of my colleagues at M.I.T. Support from various Government agencies,[20] and from the Bausch & Lomb Optical Company and the Jarrell-Ash Company has been listed elsewhere, and is here again gratefully acknowledged.

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[20] This project is at present receiving support under Air Force Contract AF 19(604)-1965.

THE CONDITIONS OF OCCURRENCE OF PHANTOM LIMBS[1]

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ALMOST ninety years ago Weir Mitchell (9) coined the term *phantom limb* to describe the amputee's experience of the continued presence of a limb which has been lost. Immediately after amputation, as he awakes from the anesthesia, the patient may not believe that the arm or leg has been removed until he can convince himself by looking under the covers. But even once he knows beyond doubt that the extremity is gone, he typically continues to feel it as if it were still present. In the days—and years—to come, the foot of the amputated leg may itch and, as the patient reaches down to scratch it, he reaches for an empty space. He may feel the bedsheets on the arm or leg, he may feel a mild, perhaps pleasant tingling—a phenomenon which Henderson and Smyth (5) regard as basic—or, much more rarely, he may feel pain. He may feel that he can wiggle his finger or toes, flex or extend the wrist or ankle, and that he can perform these movements more or less at will. Despite his knowledge that the amputation has been performed the patient may "forget" and reach out with the missing hand to grasp something, or to steady himself, or he may step on the phantom foot and fall. At least initially a good many amputees report that they are more aware of the phantom extremity—even though painless—than of the contralateral intact limb, an observation already recorded by Weir Mitchell (9).

When the phantom first appears the experience is usually—though not always—that of the limb as if it were still present, i.e. the phantom has "normal" size, shape, etc. In time, however, certain changes take place. The less articulated parts, such as the calf or the forearm, may fade and eventually drop out altogether, leaving only the foot, and eventually perhaps only the toes, or, correspondingly, leaving only the hand and finally only the fingers. Furthermore, the remaining parts may gradually "move" towards the stump—this is the famous telescoping—and there may be a general decrease in size, that is, the patient reports that the phantom foot is much smaller than the real foot used to be, much smaller than the healthy foot of the other leg. Some authors (5, 6) have reported that these changes, i.e. the telescoping and the diminution of the persisting parts, can be observed almost invariably provided some time has elapsed since the amputation. My own findings are not altogether in agreement with this view. Despite careful questioning, some patients insist—many years after they have lost a leg—that they feel the phantom foot at the "correct" distance, for example in the shoe of the prothesis, and that it is of "correct" size, i.e. of the same size as the foot of the healthy other leg. In some instances this lack of change may be related to the wearing of a prothesis, but apparently not in all. Moreover, many patients do experience telescoping and decrease in size of the phantom despite the fact that they are wearing an artificial leg or arm.

These and other characteristics of the phantom have been described in detail elsewhere (16). It seems to me that the classical argument concerning the "peripheral" *versus* "central" origin of the phantom is not only outdated, but contains basic logical fallacies. Historically it is easy to understand. Events at the periphery, i.e. in the stump and the neuroma were of great interest to the neurologists at the end of the last century, and "brain events" caught the imagination of their colleagues a generation later. It is also true that there are some important peripheral conditions which we cannot ignore and which, in fact, merit much more systematic attention and study than they have received heretofore. At the same time, the statement that the phantom originates in the brain is essentially a tautology; it is true, almost by definition, of the contemporaneous experience of the phantom, just as it is true of any differentiated cognitive activity, and it does not say anything specifically about the how and wherefore of the phantom experience.

I find it more convenient and more fruitful to

[1] A condensed version of this paper was presented at the XVth International Congress of Psychology held in Brussels, Belgium, July 28–August 3, 1957. A grant from the Max Schlossberg Foundation is hereby acknowledged with gratitude.

regard the phantom very generally as the result of learning, as the outcome of past cognitive experience in terms of which the individual acquires a schema of his body. I prefer Head's (3) concept of the "body schema" to Schilder's (15) "body image," because the latter is beset with a multitude of secondary problems which, at least for the present, I hope to avoid. Given the opportunity of postural, kinesthetic, and tactile stimulation, a periphery sensitive to such stimulation and capable of transmitting it, a central nervous system to integrate the successive messages from the periphery and to serve as the physiological basis for some kind of time-binding process making past experience available and thus learning possible, the young individual begins to acquire a geographical model of his body. A very early symptom of such learning is the postural adjustments that very young infants learn to make as they are being lifted from their crib, and which some sick infants do not learn to make. Let us recall in this connection also the Penfield homunculus (10) and the fact that it represents tactile acuity and discrete movements, both of which become highly differentiated as a function of experience. Therefore, such experience itself must be distributed according to the homunculus pattern. The developing individual must receive most stimulation in the most sensitive areas, and this would be so even were he not surrounded by other human beings providing stimulation according to their own, essentially similar homunculus patterns.

In this fashion the cognitive schema of the body is built up, beginning in very early childhood. Once it has reached a certain degree of articulation however, it is apparently quite limited in the further alterations it can undergo. This resistance to change provides the basis for the phantom. Briefly, we regard the phantom as the symptom and result of a discrepancy between the schema and physical reality. Reality can change—a leg may be lost in an accident—but the schema persists, and the phantom is the experiential representation of this persistence.

Whatever its ultimate merit may be, this approach to the problem has one great advantage: we can vary the conditions of the cognitive experience, at least clinically, if not experimentally in the strict sense, and we can observe the effect of the different conditions on the phantom. Further, in so far as the phantom is viewed as a manifestation of the schema, we can utilize our findings concerning phantoms to arrive at a better understanding of the schema—a concept which has not always been used with great precision and sometimes perhaps rather too imaginatively.

As a first step in this series of studies we have tried to analyze the conditions under which phantoms occur and those under which they fail to appear. In the introductory description I mentioned only amputation phantoms, that is, phantoms which result when the patient loses an extremity, or part of an extremity in an accident or by surgical removal. Let me add that phantoms appear not only after the loss of an extremity, but they occur just as typically after amputation of other parts such as fingers, toes, the nose, the eyes, the breast, and the genitals.

Moreover, amputation *per se* is not a necessary condition for phantoms. They are observed equally after complete denervation by plexus lesion or spinal cord transection, and they seem to occur at least in certain types of complete section of peripheral nerve as well as occasionally after cerebral lesions, especially thalamic lesions which leave the patient with a paralyzed and anesthetic extremity. Under all these conditions the limb itself is of course still present, though paralyzed and anesthetic owing to the disruption of the sensory and motor pathways. Nevertheless, the patient experiences sensations as well as voluntary and, more typically, involuntary movements. These are the phantoms. Frequently the paraplegic patient feels his legs in a position different from their actual position (1). The patient with a lesion of the brachial plexus whose arm is hanging down may report that it feels as if the arm were bent at the elbow and lying across his chest. In patients with a high cervical (14) or a thalamic lesion (18) there may be reduplication, i.e. the patient may feel as if he had two sets of arms or legs, even though he recognizes that this must sound pretty ridiculous when he tells it.

Thus, for all practical purposes it does not seem to matter whether sensory and motor functions of a given structure have been eliminated through loss of the structure itself or through denervation. Phantoms result in either case and, within certain limits at least, are quite similar. There may be some differences between phantoms resulting from these two conditions, but this is a problem for future study. In any case, interesting though it may be, it is irrelevant for our present purposes.

There are, however, two sets of factors common to amputation and denervation, factors which would appear extremely relevant and worthy of detailed exploration. In the first place, what

happens if there is not total denervation but if, instead, only the sensory system is disrupted, leaving the motor system intact, or, conversely, if only the motor system is affected, without primary insult to the sensory system. This question is more complicated than it looks. Think of postural and kinesthetic sensitivity. If these are eliminated, movement changes in very important ways. Conversely, when the patient is paralyzed, these systems are secondarily inactivated. We hope to study some aspects of this problem, for instance, in patients with anterior poliomyelitis. I am especially eager to find some patients with a Brown-Sequard phenomenon, a syndrome which occurs with hemisection of the spinal cord and consists of contralateral loss of pain and temperature sense below the level of the lesion, homolateral spastic paralysis, and loss of deep sensibility at and below the level of the lesion.

The second factor common to amputation and denervation is that both occur suddenly. If we regard the phantom as the sign of a discrepancy between the schema which has been established over a long period of time, and suddenly altered reality, then the question of the suddenness of the change is of great importance. Under the above described conditions the schema clearly cannot change with the speed of the physical insult, and thus phantoms appear. What would happen, however, if denervation or loss of structure proceeded very gradually? Would a similar hiatus result in phantoms, or would the schema be able to change gradually along with the slow physical changes?

This problem was investigated in a group of subjects who had suffered absorption of digits as a result of leprosy. The process of absorption in this illness is a very gradual one which frequently takes ten years or more to completion, and which is preceded by gradual sensory loss. The details of this study have been published recently (17), and only the major findings are relevant here. Table 1 shows the results of my interviews with eighteen patients at the National Leprosarium at Carville, Louisiana. Forty "instances of loss" result from the fact that most of these patients had suffered multiple losses. Each of them had undergone at least one major amputation, which had produced the usual amputation phantom. In addition, nine patients had lost digits through absorption, and not one of these patients had ever experienced phantoms of structures lost in this manner. Some of the patients spontaneously compared this absence of phantoms to their vivid

TABLE 1

THE OCCURRENCE OF PHANTOMS FOR 40 INSTANCES OF DIFFERENT TYPES OF LOSS IN 18 PATIENTS WITH LEPROSY *

	Amputation	Absorption with amputation and/or multiple surgery	Absorption with muscle or tendon transplants	Absorption only, no surgery	Total
Phantoms	20	7	0	0	27
No phantoms	1	1	2	9	13
Total	21	8	2	9	40

* For details see Simmel, M. L., Phantoms in patients with leprosy and in elderly digital amputees, *Amer. Jour. Psychology* **69**: 529–545, 1956.

amputation phantoms and concluded that they had never felt phantoms of the absorbed digits "because they had been dead so long ago." There were also eight instances where, in the process of absorption, one or more digits had become infected and gangrenous, which necessitated surgical amputation of the remaining part of these digits. The eight instances in which such amputation was superimposed on the absorption process are listed in the second column of table 1. Under these conditions phantoms appeared in all but one instance. Moreover, such phantoms were not only of that part of the digit which had still been present just prior to amputation; rather, they were of the whole digit before any absorption had taken place. That is, the fact of earlier partial absorption had now become irrelevant. We have further evidence for this. When absorption of toes had preceded the amputation of a leg, the amputation phantom contained toes, even though their prior absorption had not resulted in phantoms. These additional findings are not represented in table 1, but are given in the above mentioned earlier article (17). Finally, there were two patients in whom muscle and tendon transplants were undertaken many years after absorption was complete. Even though this is a very small sample, it is interesting to note that phantoms did not occur in these two instances.

Several conclusions can be drawn from the data of this study. In the first place amputation of a gangrenous extremity in patients with leprosy produces typical amputation phantoms. This was of course not an unexpected finding, but it does serve as a nice control for the other results. Secondly, phantoms do not appear upon absorption of digits. This must indicate that the cognitive schema of the body is indeed capable of under-

going gradual alteration paralleling slow progressive changes of the body—in this particular case the progressive loss of digits. But it should be remembered that under normal conditions too the schema must reflect gradual small changes of body contours, and of special sensory, motor, and emotional articulations which develop in the course of the individual's life. Thus, while the absence of phantoms of absorbed digits may be a rather spectacular finding, it should not be regarded as an isolated special case. It simply highlights the temporal aspects of normal processes which establish and maintain a veridical body scheme.

We have a third finding, however, with more problematical implications. If amputation is superimposed on an on-going process of absorption, the full digit is represented in the phantom, not only the absorption remnant which had been surgically removed. In other words, the sudden loss of the already partially absorbed digit gives rise to the *occasion* for the phantom; once this occasion is provided, the ensuing phantom is that of the full digit before any absorption had taken place. This seems to imply that the schema is not all of one piece, that, while undergoing gradual changes, it seems to retain a "memory" of its previously attained stable organization. It indicates further that the new schema which has developed as the result of the on-going absorption lacks the stability of that earlier scheme which the patient had attained prior to his illness.

These findings prompted us to turn our attention to those conditions under which the lost extremity might never have been part of a stable cognitive schema. I would like to report three sets of data bearing on this problem: an investigation of child amputees in whom the incidence of phantoms was studied as a function of the chronological age at amputation; an investigation of mental defective amputees for whom the reports concerning phantoms were compared against the presumptive mental age attained at the time of the amputation and also at the time of the interview; and a study of a group of patients with congenital absence of extremities.

Table 2 shows the findings for thirty-three child amputees whom I interviewed in the past year in Dr. Claude Lambert's clinic at the University of Illinois Research and Educational Hospitals.[2] The patients came to this clinic primarily in order to have minor adjustments made in their protheses, or to have a new prothesis fitted. None was in any acute distress. They had undergone amputation between the ages of five months and fifteen years, largely as the result of accidents, though in a few cases surgical removal of an extremity was necessitated by a tumor. At the time of the examination the patients ranged between the ages of four years and sixty years. For the youngest patients the interview was held almost exclusively with the parents; all others were interviewed personally and, in addition, parents or relatives who accompanied some of the patients to the clinic were also questioned.

As can be seen in the table, none of the five patients (#301–#305) who had undergone amputation prior to age three years gave any evidence of ever having experienced a phantom. By contrast, all of the patients whose amputation occurred after age seven (i.e., #317–#333) reported phantoms which, in all but two cases (#323 and #330), were still persisting.

There remains the middle group of eleven patients (#306–#316) who had undergone amputation between the ages of three and seven. The majority of these patients report phantoms, but some do not. In this small group it appears that the patients with phantoms underwent more extensive amputation than those without phantoms, but whether this relationship would hold up with a larger sample is questionable. These studies are being continued in the hope that it will eventually be possible to identify those factors which may be responsible for the presence or absence of phantoms after amputation in this age group.

To my knowledge the literature contains only one other study of child amputees. Riese and Bruck (13) examined twenty-four young patients, and concluded that they had no evidence of phantoms following amputation prior to age six or seven years. I suspect that the main reason for the apparent discrepancy between the finding of those authors and mine is the fact that we had the parents of the younger children available. Indeed, in two of our cases the listing in the table is based on the parent's report: one of these, #311, was a very shy little boy who would not

[2] I am greatly indebted to Dr. Claude N. Lambert of the Department of Orthopedic Surgery, College of Medicine, University of Illinois, for allowing me to participate in his bi-weekly Amputee Clinic and to interview his patients. All the data from child amputees as well as those of patients with congenital malformation or absence of extremities have been obtained in Dr. Lambert's Clinic. These studies are being continued, partly in order to increase the size of the samples, partly because new questions arise constantly, problems which might have fundamental significance for our understanding of the phantom.

TABLE 2

PHANTOMS REPORTED FOR AMPUTATIONS (OF PREVIOUSLY NORMAL EXTREMITIES) IN CHILDHOOD, AS A FUNCTION OF AGE AT AMPUTATION

No phantoms				Phantoms			
Case #	Age at amputation	Amputation site	Age at interview	Case #	Age at amputation	Amputation site	Age at interview
#301	0-5	left above elbow	8-10				
#302	0-7	right above knee	8-3				
#303	1-6	left above elbow	8-4				
#304	1-10	right above elbow	4-2				
#305	2-7	right above elbow	12				
				#306	3-5	left above elbow	9-9
#307	3-10	right foot	4-2				
#308	5-1	right below knee	5-9				
				#309	5-2	right above knee	12
				#310	5-4	bilat. below knee	14
				#311	5-4	right below elbow	7-10
#312	5-6	right 3rd finger	60				
				#313	5-10	right above knee	15
				#314	6-3	right above elbow	7-1
#315	6-8	right below knee	7-9				
				#316	6-9	bilat. below knee	9
				#317	7-6	right above elbow	17
				#318	7-8	right foot	18
				#319	9-5	left foot	16
				#320	9-6	left below elbow	14
				#321	9-10	right below knee	19
				#322	9-11	left hand	15
				#323	10-6	right above knee	56
				#324	11-4	left below elbow	11-7
				#325	11-5	left shoulder	12
				#326	12-8	right hand	16
				#327	12-11	left hip	15
				#328	13-0	right below elbow	15
				#329	13-0	left above knee	13-2
				#330	13	right above knee	36
				#331	13-3	bilat. above knee	13-9
				#332	14	right below elbow	14-3
				#333	15-1	right below knee	16-4

talk to me at all but who, having listened to my conversation with the mother, "showed" me how he could move the fingers of the missing arm; the other, #313, insisted that he did not remember ever having experienced any phantom, even though his mother described that during the first year following the amputation he had frequently complained that the toes of the missing foot were itching.

To summarize: It seems that when a previously normal extremity is amputated in the very young, i.e. before age three years, or perhaps still earlier, phantoms do not appear; amputation between ages three and seven years may or may not result in phantoms; amputation after age seven is followed predictably by phantom experiences.

Let us turn now to the next study in which I attempted to find out whether mentally defective amputees have normal phantom experiences. This is relevant in so far as a certain minimal intellectual level, or a minimal adequacy of cognitive functioning may well be requisite for the establishment of a differentiated body scheme. In the preceding study we learned that the development of phantoms in normal child amputees is, within certain limits, a function of chronological age at the time of amputation. One might further assume that the mental age at amputation is either the single crucial factor in this, or at least a very important one. Within the limits of the intellectually normal group with which we were dealing, chronological age and mental age could not be independently varied to any significant degree. Moreover, there is a myth that "feeble-minded

amputees do not have phantoms," a statement which is frequently heard in informal discussions, and perhaps implied in occasional publications. Yet, to my knowledge, no systematic study had ever been made of this question.

The subjects of this inquiry were all amputees residing in the two Illinois State training schools for mental defectives and in three similar institutions in Massachusetts.[3] Those with congenital absence of extremities and adults with mental ages above eleven years were not included. This left twenty-six subjects whom I interviewed with more or less success. At the time of the interviews the patients' chronological ages ranged from eight to seventy-two years, estimated mental ages from less than one year to ten years and three months, IQs from less than thirty to sixty-eight. The corresponding figures for the time of amputation are: CA 4–3 to 60; MA < 1 to 10–0; IQ < 30 to 100.[4] The time elapsed since amputation varied from a few months to forty-four years.

The details of this study have been published elsewhere (19) and the findings can be summarized here very briefly. The twenty-six patients fell into two groups: (*a*) fourteen patients from whom no creditable evidence could be obtained, either because communication *per se* was impossible, or because they cheerfully agreed to everything I said, without any awareness of the inconsistencies resulting from this procedure; (*b*) twelve patients who gave consistent and apparently reliable information. Eleven of this latter group provided typical descriptions of amputation phantoms, and only one reported no phantom. Except for a small number of patients at the idiot level who necessarily belonged to group (*a*), chronological ages, mental ages, and intelligence quotients were much the same for the two groups, even though medians tended to favor group (*b*). The educational attainment of the two groups was, however, quite different. At least seven of the eleven patients giving positive evidence of phantoms had reached the third grade and, as far as we know, only one never attended school. In sharp contrast to this, only one of the fourteen patients who could not give reliable information had reached the third grade, and at least five had never attended classes. This relationship suggests that a certain minimal level of cognitive stability and differentiation is a common prerequisite (i) for the ability to profit from primary grade instruction especially with regard to reading and writing; (ii) for the development of phantoms following amputation; (iii) for the ability to give reasonably consistent reports of an experience such as the phantom, and (iv) that, at least in the mental defectives, mental age and IQ scores may not be adequate indicators of the level of cognitive maturity attained. These findings should dispose of the myth that mental defective amputees do not have phantoms. To be sure, from a good many of such patients one cannot obtain creditable information—but this is not the same as to say they lack phantoms. For those patients who can give reasonably reliable reports, phantoms appear to be the rule.

Let us proceed to the final study, that of patients with congenitally missing extremities. Here we are confronted with a statement of Pick (11) to the effect that such patients lack phantoms, a statement which is reiterated throughout the literature without any supporting evidence but which nevertheless appears to be essentially correct. In Dr. Lambert's clinic I have had the opportunity to interview eighteen patients with congenital absence of part or all of one upper extremity. The defect involved the left side in fourteen of these subjects, the right side in four; it was limited to the hand and forearm in fourteen and extended above the elbow in the remainder. The patients' ages ranged from six years, four months to nineteen years at the time of the interviews. In the case of the younger ones the parents also were questioned carefully. Not one of these eighteen individuals gave any evidence of ever having experienced a phantom. All insisted that they had never felt any fingers or the hand which was missing. In marked contrast to the amputees, these patients had even some difficulty in understanding what I was asking about, despite their normal intelligence and evident willingness and cooperation. In other words, I was clearly trying

[3] I would like to express my gratitude to Dr. Clemens E. Benda, Director of Psychiatry, Walter E. Fernald State School, for making the arrangements which enabled me to examine patients at the Walter E. Fernald State School, Waverly, Mass.; at the Wrentham State School, Wrentham, Mass.; and at the Myles Standish State School, Taunton, Mass. I would also like to thank the staff members of these institutions as well as those at Dixon State School, Dixon, Ill., and Lincoln State School, Lincoln, Ill., for their cooperation.

[4] These figures are extrapolated from whatever data were available in the institutions' records. Two patients were said to have been "normal" prior to an accident in childhood when they incurred severe brain injury along with damage necessitating amputation of an extremity. For these patients the mental age at the time of amputation was estimated to correspond to the chronological age at that time, i.e. IQ at amputation was listed as 100.

to discuss with them a matter quite outside their experience. To this group might be added two further patients with bilateral congenital aplasias. Neither had ever had any phantom, but the fact that these subjects lacked a contralateral, healthy extremity for comparison led me to exclude them in the first place.

There is, however, another group of patients who are sometimes referred to as congenital amputees. These are patients with severe congenitally malformed extremities which are subsequently amputated in order to fit a workable prothesis. I have examined fifteen such patients from Dr. Lambert's clinic, and the results are presented in table 3, where they are arranged in the order of age at amputation. Omitting for the moment case #454, it looks again as if those who underwent amputation earlier have no phantoms, while those with late amputations do. There is, however, another crucial factor, namely, that of pre-amputation function of the malformed extremity. For the majority of patients these two factors are intrinsically confounded, since a completely useless extremity will tend to be amputated at an earlier age than one which has some function and where the surgeon and the relatives are more likely to hesitate and await further developments. But we have at least one case, #464, who underwent amputation of a non-functional hand remnant at age twelve years and who, in the nine months since amputation, has never experienced a phantom.

Finally, we come to that puzzling little girl, listed here as case #454, who underwent amputation at one and one-half years of age and who, by her own reports as well as that of her aunt, has had experiences which we can only classify as phantoms. At first we considered that, since she had been fitted with protheses very soon after amputation and had learned to walk on these, the protheses themselves had become part of body scheme during its formation. But neither is this in accord with the child's complaint at age three that "her ankles hurt," nor have we any cor-

TABLE 3

PHANTOMS REPORTED FOR AMPUTATIONS OF CONGENITALLY MALFORMED EXTREMITIES, AS A FUNCTION OF AGE AT AMPUTATION

No phantoms					Phantoms				
Case #	Amputation site	Age at amp.	Pre-amputation function	Age at inter.	Case #	Amputation site	Age at amp.	Pre-amputation function	Age at inter.
#451	left above elbow	0-2	*None.* Arm fractured and gangrenous at birth.	11					
#452	right below knee	1-2	*None?* Apparently did not walk prior to amp.	12					
#453	right below knee	1-5	*None?* Apparently did not walk prior to amp.	15					
					#454	left below knee right above knee	1-6	*Yes.* Active crawling on knees prior to amp.	10
					Note: Very intelligent and active youngster. *Phantom:* At age 3 complained for a short time that "her ankle hurt." Now feels protheses "like real legs, except when wearing tennis shoes."				
#455	right below knee	1-7	*None.* In cast since age 4 months.	6-3					
#456	left below knee	2-6	*None.* In cast since age 2 months.	10					
#457	right above elbow	3-10	*None?* Apparently did not use rudimentary forearm, though minimal motion and normal? skin sensitivity.	4-2					
#458	right above elbow	5-4	*None.* Non-functional hand remnant, no motion, no? skin sensitivity.	9					
					#459	bilat. above knee	9-0	*Yes.* Active crawling on knees until age 6 years, then wheelchair.	16
					#460	right above knee	9-5	*Yes.* Had walked on leg prior to amp.	18
					#461	right above knee	10-6	*Yes.* Had walked on leg prior to amp.	10-10
					#462	right below knee	11-4	*Yes.* Walked in walking cast prior to amp.	21
					#463	left below knee	11-11	*Yes.* Had walked on leg prior to amp.	13
#464	right above elbow	12	*None.* Non-functional hand remnant.	12-9					
					#465	right below knee	34-8	*Yes.* Had walked on leg prior to amp.	37

responding findings from the three other children with amputation of malformed lower extremities before age two, i.e. patients #452, #453 and #455, who had similarly learned to walk on their artificial legs. The only differences between these children and our little girl are (i) that she had actively used the malformed extremities, while the others had not; and (ii) that both her legs were affected while the others underwent unilateral below knee amputation. While this little girl is obviously bright, and might well have been intellectually advanced even at one and one-half years, two of the other three children were probably not far behind her.

In conclusion, let us see what we have learned from the several studies which have been presented. As a starting point we considered the phantom as a sign of a cognitive schema of the body, a schema which develops in the course of the individual's life and persists beyond the time at which a given body part is lost. In this connection we discovered that the term "loss" is to be understood, at least for the time being, as a loss of sensory and motor function resulting from complete denervation with or without amputation. Upon such a loss there arises a discrepancy between the physical, functional reality and the unchanged body schema. The latter now reflects something more than the true state of affairs warrants. This "more" is the lost body part, and it manifests itself experientially as the phantom.

To test this conception of the phantom we undertook to study more precisely the limiting conditions under which phantoms may or may not occur. Our experiments were directed at three distinct loci: (i) the process of loss; (ii) the representation of the affected part in the cognitive scheme prior to the loss; (iii) the cognitive scheme itself.

(i) *The process of loss.*—Loss of sensory and motor function through amputation or section of the neural pathways is sudden and produces phantoms. We asked ourselves whether a gradual loss would create a similar hiatus between reality and a persisting schema, and thus phantoms, or whether the schema can change gradually along with the physical change, and thus result in absence of phantoms. Our first experiment shows that the latter is indeed the case. The slowly progressive loss sustained in digital absorption due to leprosy does not produce phantoms, provided there is no additional sudden loss due to a superimposed amputation. The lack of phantoms of gradually absorbed digits indicates that in this situation the body scheme can undergo slow changes paralleling the progression of bodily changes. Moreover, we considered that similar gradual changes in time must be a normal characteristic of the schema without which it could not remain veridical. But we also found that, at least with respect to digital absorption, the gradual alterations of the schema are not as irreversible as one might have thought. This poses a problem which will have to be considered much more systematically at some future time.

(ii) *The representation of the affected body part in the cognitive scheme prior to amputation.*—When Sir Henry Head advanced the concept of the schema of the body, he derived it from postural, kinesthetic, and tactile experiences of the individual. If a person lacks an extremity since birth, he has never received such sensations from the missing limb, and he should therefore not have a phantom. Our studies indicate that this is exactly what happens. None of our patients with a congenitally missing hand or arm had ever experienced a phantom. The same was found to be true in patients born with severely misshapen extremities, members which had never had any functional use and which were eventually amputated. These patients did not have phantoms either. There was, however, a second group of patients with congenital malformations. The individuals of this group had had some use of their severely abnormal limbs; they had crawled on their knees and had even walked, though badly and with difficulty. Sooner or later the abnormal leg had been amputated in order to fit the patient with a prothesis. Evidently even this limited use had been sufficient to establish the member as part of the body scheme, because once it had been surgically removed, the patients reported phantoms.

(iii) *The cognitive schema.*—We have assumed with Head that the cognitive schema of the body is built up as a function of the individual's experience, i.e. that it owes its existence to the individual's capacity and opportunity to learn. This means that at some early time in the development of the human organism the schema has not yet been formed, while later—at least in adulthood—it is present and is characterized by considerable differentiation and stability. Can we specify the age and level of mental development at which the schema has attained the degree of differentiation and stability requisite for the appearance of a phantom?

Our studies of normal child amputees and of mentally defective amputees addressed themselves

to that question. The data from the child amputees indicate that the necessary level of cognitive organization is attained in the course of normal development at least by age seven years, and in some individuals much earlier. Several aspects of the findings of this study need to be explored in greater detail, and eventually we should be able to correlate the results with other cognitive achievements at the various age levels. Let me give one or two illustrations. In those experiments in which perceptual constancies can be shown to improve with age, the level attained at age seven is usually that of the final adult performance, even though there may be additional improvement up to age ten or twelve which is then followed by a drop during adolescence (*2*). Furthermore, by age seven most children have acquired the necessary stability and differentiation of cognitive organization which enables them to learn to read and write, but a few otherwise intelligent children are not able to master these perceptually complicated skills until a somewhat later age. There are of course a good many children who achieve this level of cognitive maturity much earlier, many at age five, some even before that. In view of these individual differences we should not be too surprised if we cannot establish a single absolute age limit below which phantoms are never reported and above which they inevitably occur. With regard to the mental defectives, it is well known that some with mental ages below seven years manage to acquire at least the rudiments of reading and writing. This provides at least partial support for our finding that apparently reliable accounts of phantoms were significantly correlated with educational attainment.

It is evident that the experiments here reported are only a beginning. The findings of each study have posed new problems which need to be explored systematically. Yet, this very fact may be considered as proof of the fruitfulness of the present approach. If, at some future date, the approach no longer provides answers or questions we will at least know what its deficiencies are. For the time being there is much to be gained by viewing the phantom as a sign of a persisting schema of the body, a schema that cannot change with the speed of the sudden physical loss due to amputation or denervation. The lost part of the body continues to be represented in the schema beyond the time of the insult and manifests itself experientially as the phantom.

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THE DEVELOPMENT OF AFFECTIONAL RESPONSES IN INFANT MONKEYS[1]

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HUMAN beings have long observed the development of affection or love in the neonate and infant. It is an obvious fact that this early affection of the infant is first intimately bound to the mother and then gradually expands, through mechanisms by no means well known, to other human beings.

Observational evidence, often controlled, orderly, and systematic, has led scientists to speculate both on the nature of the early affectional responses and the development and generalization of these responses. Although experimental psychologists have given little attention to the fundamental nature or development of affection, their common theoretical position is that affection is a derived drive developed through the repeated association of the mother with reduction of the primary biological drives, particularly hunger and thirst.

A wide diversity of theoretical positions has been held by various psychoanalysts. Some, such as Klein (3), have emphasized the breast as an object for which the infant innately strives and connects, whereas others, including Winnecoot (7) and Ribble (5), have described broader innate needs relating to contact, movement, and temperature. Bowlby [2] has given approximately equal emphasis to primary clinging (contact) and sucking as innate affectional components, and at a later maturational level, visual and auditory following.

The role of visual and auditory following (imprinting) has been stressed by Lorenz (4) and other ethologists as primary innate mechanisms binding the infant bird and fish to the mother. Even if similar mechanisms exist in the primate, they appear at a later developmental stage and play less important roles than they do in lower animals.

There are many reasons for the absence of experimental analysis of the nature and development of affectional responses in the human infant. His motor capabilities are so limited at birth that there are few, if any, precise responses that can be measured and recorded, and by the time his precise responses can be measured, the antecedent determining variables have been obscured in a complex maze of confounded variables previously unmeasurable.

Fortunately, these difficulties are resolved in large part if we use the neonatal and infant macaque monkey as the subject for the experimental analysis of basic affectional variables. It is possible to make precise measurements in this primate beginning at two to ten days of age, depending upon the maturational status of the individual subject at birth. The macaque infant differs from the human infant in that the monkey is more mature at birth and grows more rapidly, but the basic responses relating to affection, including nursing, contact, clinging, and even visual and auditory exploration, exhibit no fundamental differences in the two species. Even the development of perception, emotion, and learning capability follow very similar sequences.

In an effort to gain complete control over the lives of the monkeys used as subjects for affectional analysis, we separated these animals from their mothers six to twelve hours after birth and suckled them on tiny nursing bottles. Three years' previous experience with some sixty neonates, also separated from their mothers at birth, had demonstrated the complete feasibility of such procedures, for these earlier laboratory-raised monkeys were larger and healthier and had a higher incidence of survival than infants left to the care of their monkey mothers.

We had noted that the previous laboratory-raised babies showed strong attachment to the cloth pads (folded gauze diapers) which were used to cover the hardware-cloth floors of their cages. The infants clung to these pads and engaged in violent temper tantrums when the pads

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[2] Personal communication from Dr. John Bowlby, Tavistock Clinic, London, England.

FIG. 1. Response to cloth pad by one-day-old monkey.

were removed and replaced for sanitary reasons. Such contact-need or responsiveness had been reported previously by Van Wagenen (6) and is reminiscent of the devotion often exhibited by human infants to their pillows, blankets, and soft, cuddly stuffed toys. Responsiveness by the one-day-old infant monkey to the cloth pad is shown in figure 1, and an unusual and strong attachment of a six-month-old infant to the cloth pad is illustrated in figure 2.

We took these observational data as the cue for the construction of two mother surrogates, one designed to be soft, the other to be rigid and unyielding. Figure 3 shows the two mothers. On the right is a cloth mother made from a block of wood covered by sponge rubber and sheathed with terry cloth. The wire mother on the left is made of hardware cloth, a substance entirely adequate to provide support and nursing capability. We presumed that the cloth and wire mothers would differ to the neonatal monkeys in no way other than the difference in contact comfort provided by the mother's body. Although we deliberately designed different faces for the two classes of mothers, responsiveness to the face matures at a later age than affectional responding.

FIG. 2. Response to gauze pad by six-month-old monkey used in earlier study.

FIG. 3. Wire and cloth mother surrogates.

In our initial experiment, the dual mother-surrogate condition, a cloth mother and a wire mother were placed in different cubicles attached to the infant's living cage (see fig. 3). For four infant monkeys the cloth mother lactated and the wire mother did not, and for the other four this condition was reversed. In either condition the infant received all its milk through the mother surrogate as soon as it was able to maintain itself in this way. In the first few days, supplementary feedings were needed, but these could be eliminated after two or three days except in the case of very immature animals. Thus, the experiment was designed as a test of the relative importance of the variables of contact comfort and nursing comfort. During the first fourteen days of life the monkey's cage floor was covered with a heating pad wrapped in a folded gauze diaper, and thereafter the cage floor was bare. The infant subjects were always free to leave the heating pad or cage floor to contact either mother, and the time spent on the surrogate mothers was automatically recorded. Figure 4 shows the total time spent on the cloth and wire mothers under the two conditions of

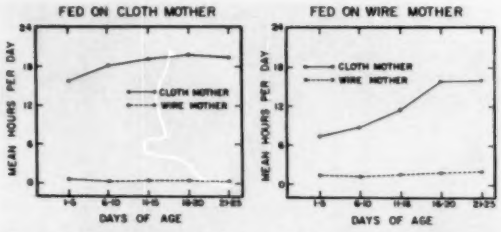


FIG. 4. Time spent on cloth and wire mother surrogates.

feeding. These data make it obvious that contact comfort is a variable of overwhelming importance in the development of affectional responses, whereas lactation is a variable of negligible importance. With age and opportunity to learn, responsiveness to the lactating wire mother decreases and responsiveness to the nonlactating cloth mother increases, a finding completely contrary to any interpretation of derived drive in which the mother-form becomes conditioned to hunger-thirst reduction. The persistence of these differential responses throughout 165 consecutive days of testing is evident in figure 5.

We were not surprised to discover that contact comfort was an important basic affectional or love variable, but we did not expect it to overshadow so completely the variable of nursing; indeed, the disparity is so great as to suggest that the primary function of nursing as an affectional variable is that of insuring frequent and intimate body contact of the infant with the mother.

One function of the real mother, human or subhuman, and presumably of a mother surrogate, is to provide a haven of safety for the infant in times of fear and danger. The frightened or ailing child clings to its mother, not its father, and this selective responsiveness in times of distress, disturbance, or danger may be used as a measure of the strength of affectional bonds. We have tested this kind of differential responsiveness by presenting to the infants in their cages, in the presence of the two mothers, various fear-producing stimuli such as the moving toy bear illustrated in figure 6. The data on differential responsiveness are presented in figure 7, and it is apparent that the cloth mother is highly preferred over the wire one, and this differential selectivity is enhanced by age and experience. In this situation, the variable of nursing appears to be of absolutely no importance; the infant consistently seeks the soft mother surrogate regardless of nursing condition.

Similarly, the mother or mother surrogate provides its young with a source of security, and this role or function is seen with special clarity when mother and child are in a strange situation.

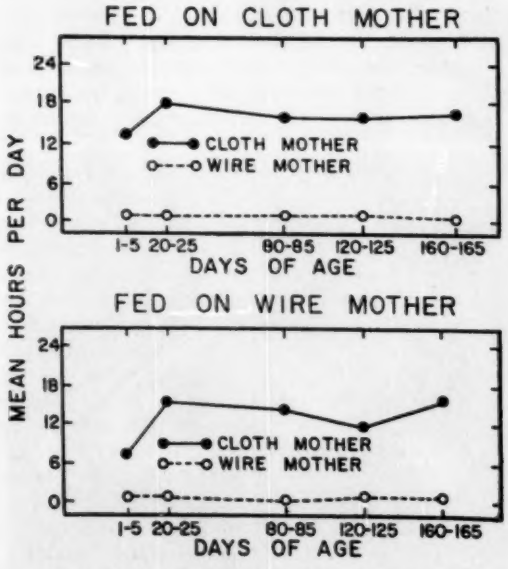


FIG. 5. Long-term contact time on cloth and wire mother surrogates.

FIG. 6. Typical fear stimulus.

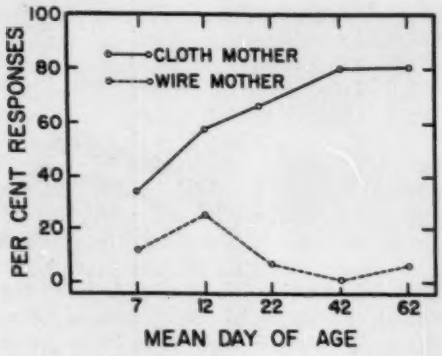


FIG. 7. Differential responses to the two mothers in fear tests.

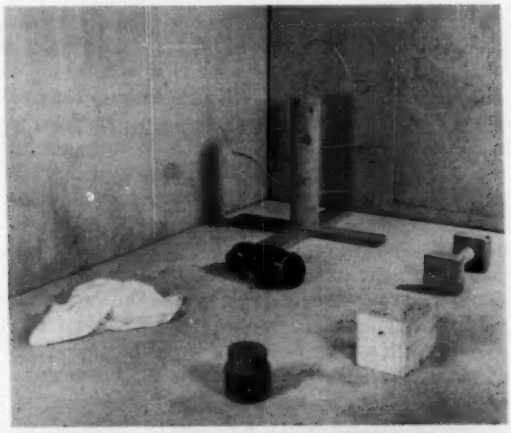
At the present time we have completed tests for this relationship on four of our eight baby monkeys assigned to the dual mother-surrogate condition by introducing them for three minutes into the strange environment of a room measuring six feet by six feet by six feet (also called the "open-field test") and containing multiple stimuli known to elicit curiosity-manipulatory responses in baby monkeys. The subjects were placed in this situation twice a week for eight weeks with no mother surrogate present during alternate sessions and the cloth mother present during the others. A cloth diaper was always available as one of the stimuli throughout all sessions. After one or two adaptation sessions, the infants always rushed to the mother surrogate when she was present and clutched her (see fig. 8), a response so strong that it can be adequately depicted only by motion pictures. After a few additional sessions, the infants began to use the mother surrogate as a source of

FIG. 8. Initial response to cloth mother in the open-field tests.

FIG. 9. Subsequent response to cloth mother in the open-field tests.

FIG. 10. Object exploration in presence of cloth mother.

security, a base of operations. As is shown in figures 9 and 10, they would explore and manipulate a stimulus and then return to the mother before adventuring again into the strange new world. The behavior of these infants was quite different when the mother was absent from the room. Frequently they would freeze in a crouched position, as is illustrated in figures 11*a* and 11*b*. Emotionality indices such as vocalization, crouching, rocking, and sucking increased sharply, as shown in figure 12. Total emotionality score was cut in half when the mother was present. In the absence of the mother some of the experimental monkeys would rush to the center of the room where the mother was customarily placed, and then run rapidly from object to object screaming and crying all the while. Continuous, frantic clutching of their bodies was very common, even when not in the crouching position. These monkeys frequently contacted and clutched the cloth diaper, but this action never pacified them. No difference between the cloth-mother-fed and wire-mother-fed infants was demonstrated under either condition. Four control infants never raised with a mother surrogate showed the same emotionality scores when the mother was absent as the experimental infants showed in the absence of the mother, but the controls' scores were slightly larger in the presence of the mother surrogate than in her absence.



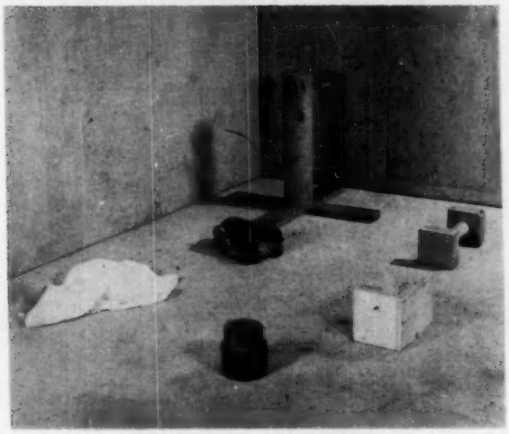


FIG. 11. *a* & *b*. Responses in the open-field test in the absence of the mother surrogate.

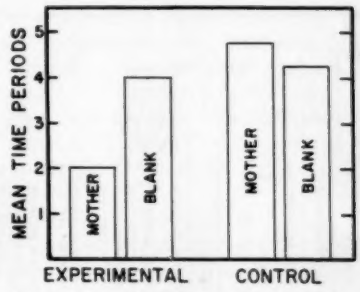


FIG. 12. Emotionality index with and without the presence of the cloth mother.

Some years ago Butler (1) showed that mature monkeys enclosed in a dimly lighted box would open and reopen a door for hours on end for no other motivation than that of looking outside the box. We now have data demonstrating that neonatal monkeys show this same compulsive visual curiosity on their first test day in an adaptation of the Butler apparatus. Usually these tests are begun at ten days of age, but this same persistent visual exploration has been obtained in a three-day-old monkey during the first half-hour of testing. Butler (2) also demonstrated that rhesus monkeys show selectivity in rate and frequency of door-opening to stimuli of differential attractiveness in the visual field outside the box. We have utilized this principle of response selectivity by the monkey to measure strength of affectional responsiveness in our infants in the baby version of the Butler box. The test sequence involves four repetitions of a test battery in which the four stimuli of cloth mother, wire mother, infant monkey, and empty box are presented for a thirty-minute period on successive days. The first four subjects in the dual mother-surrogate group were given a single test sequence at forty to fifty days of age, depending upon the availability of the apparatus, and only their data are presented.

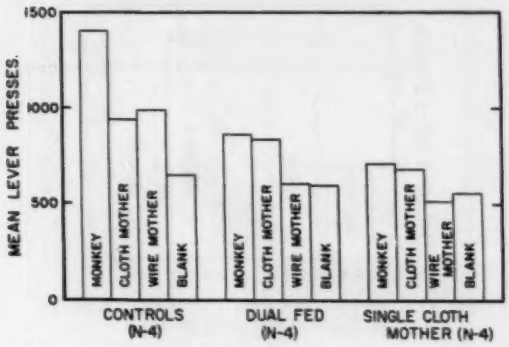


FIG. 13. Differential responses to visual exploration.

The second group of four subjects is being given repetitive tests to obtain information relating to the development of visual exploration. The data obtained from the first four infants raised with the two mother surrogates are presented in the middle graph of figure 13 and show approximately equal responding to the cloth mother and another infant monkey, and no greater responsiveness to the wire mother than to an empty box. Again, the results are independent of the kind of mother that lactated, cloth or wire. The same results are found for a control group raised, but not fed, on a single cloth mother, and these data appear in the graph on the right. Contrariwise, the graph on the left shows no differential responsiveness to cloth and wire mothers by a second control group, which was not raised on any mother surrogate.

The first four infant monkeys in the dual mother-surrogate group were separated from their mothers between 165 and 170 days of age and tested for retention during the following nine days and then at thirty-day intervals for five successive months. Affectional retention as measured by the modified Butler box is given in figure 14. In keeping with the data obtained on adult monkeys by Butler, we find a high rate of responding to any stimulus, even the empty box. But throughout the entire 160-day retention period there is a consistent and significant difference in response frequency to the cloth mother contrasted with either the wire mother or the empty box, and no consistent difference between wire mother and empty box.

Affectional retention was also tested in the open field during the first nine days after separation and then at thirty-day intervals, and each test condition was run twice at each retention interval. The infant's behavior differed from that observed during the period preceding separation. When the cloth mother was present in the post-separation period, the babies rushed rapidly to her, climbed up her body, clung tightly to her, and rubbed their head and face about her body. After this initial embrace and reunion, they played on the mother, including biting and tearing at her cloth cover; they rarely made any attempt to leave her during the test period, nor did they manipulate or play with the objects in the room, in contrast with their behavior before maternal separation. The only exception was the occasional monkey that left the mother surrogate momentarily, grasped the folded piece of paper (one of the standard stimuli in the field), and brought it quickly back to the mother. It appears that deprivation had enhanced the tie to the mother, and the contact-comfort need had become so prepotent that it overwhelmed the exploratory motives during the brief, three-minute test sessions. No change in these behaviors was observed throughout the 160-day period. When the mother was absent from the open field, the behavior of the infants was similar in the initial retention test to that during the pre-separation tests, but they tended to show gradual adaptation to the open-field situation with repeated testing and, consequently, a reduction in their emotionality scores.

In the last five retention test periods an additional test was introduced in which the surrogate mother was placed in the center of the room and covered with a clear Plexiglas box. The monkeys were initially disturbed and frustrated when their explorations and manipulations of the box failed to provide contact with the mother. However, all animals adapted to the situation rather rapidly, and soon they used the box as a place of orienta-

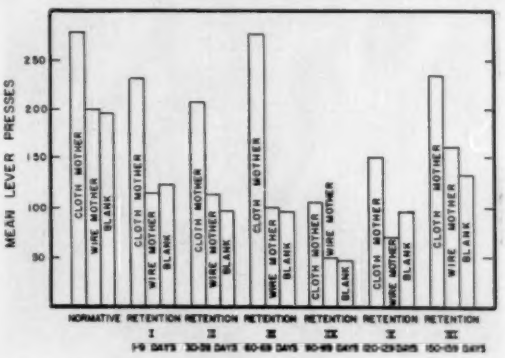


FIG. 14. Retention of differential visual-exploration responses.

tion for exploratory and play behavior, made frequent contacts with the objects in the field, and very often brought these objects to the Plexiglas box. The emotional index was slightly lower than in the condition of the available cloth mothers, but it in no way approached the emotionality level displayed when the cloth mother was absent. Obviously, the infant monkeys gained emotional security by the presence of the mother even though contact was denied.

Affectional retention has also been measured by tests in which the monkey must unfasten a three-device mechanical puzzle to obtain entrance into a compartment containing the mother surrogate. All the trials are initiated by allowing the infant to go through a locked door, and in half the trials it finds the mother present and in half, an empty compartment. The door is then locked and a ten-minute test conducted. In tests given prior to separation from the surrogate mothers some of the infants had solved this puzzle and others had failed. The data of figure 15 show that on the last test before separation there were no differences in total manipulation under mother-present and mother-absent conditions, but striking differences exist between the two conditions throughout the post-separation test periods. Even though there is an apparent trend for total amount of manipulation to decrease, the ratio of responsiveness to the mother-present and mother-absent conditions shows no sign of decreasing. Again, there is no interaction with conditions of feeding.

The over-all picture obtained from surveying the retention data is unequivocal. There is little, if any, waning of responsiveness to the mother throughout this five-month period as indicated by any measure. It becomes perfectly obvious that this affectional bond is highly resistant to forgetting and that it can be retained for very long periods of time by relatively little reinforcement of the contact variable. During the next year retention tests will be conducted at ninety-day intervals, and further plans are dependent upon the results obtained. It would appear that affectional responses may show as much resistance to extinction as has been previously demonstrated for learned fears and learned pain, and such data would be in keeping with those of common human observation.

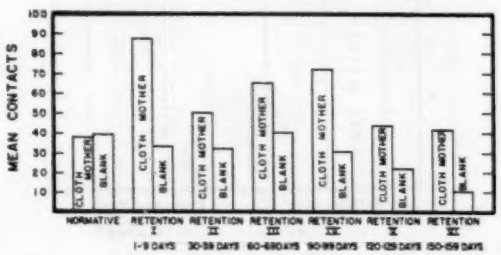


FIG. 15. Retention of puzzle manipulation responsiveness.

We have already described the group of four control infants that had never lived in the presence of any mother surrogate and had demonstrated no sign of affection or security in the presence of the cloth mothers introduced in test sessions. When these infants reached the age of 250 days, cubicles containing both a cloth mother and a wire mother were attached to their cages. There was no lactation in these mothers, for the monkeys were on a solid-food diet. The initial reaction of the monkeys to the alterations was one of extreme disturbance. All the infants screamed violently and made repeated attempts to escape from the cage whenever the door was opened. They kept a maximum distance from the mother surrogates and exhibited a considerable amount of rocking and crouching behavior, indicative of emotionality. Our first thought was that the critical period for the development of maternally directed affection had passed and that these macaque children were doomed to live as affectional orphans. Fortunately, these behaviors continued for only twelve to forty-eight hours and then gradually ebbed, changing from indifference to active contact on, and exploration of, the surrogates. The home-cage behavior of these control monkeys slowly became similar to that of the animals raised with the mother surrogates from birth. Their manipulation and play on the cloth mother became progressively more vigorous to the point of actual mutilation, particularly during the morning, after the cloth mother had been given her daily change of terry covering. The control subjects were now actively running to the cloth mother when frightened and had to be coaxed from her to be taken from the cage for formal testing.

Objective evidence of these changing behaviors is given in figure 16, which plots the amount of time these infants spent on the mother surrogates. Within ten days mean contact time is approximately nine hours, and this measure remains relatively constant throughout the next thirty days. Consistent with the results on the subjects reared from birth with dual mothers, these late-adopted infants spent less than one and one-half hours per

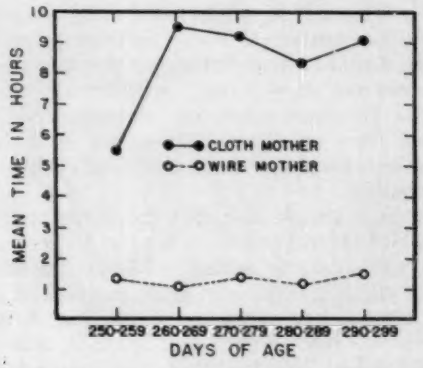


FIG. 16. Differential time spent on cloth and wire mother surrogates by monkeys started at 250 days of age.

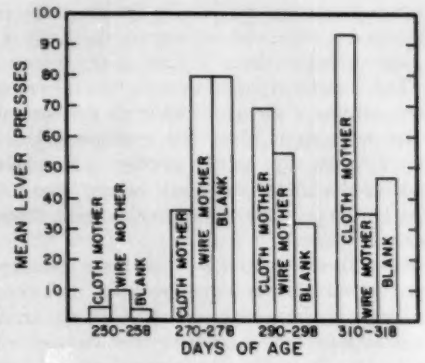


FIG. 17. Differential visual exploration of monkeys started at 250 days of age.

day in contact with the wire mothers, and this activity level was relatively constant throughout the test sessions. Although the maximum time that the control monkeys spent on the cloth mother was only about half that spent by the original dual mother-surrogate group, we cannot be sure that this discrepancy is a function of differential early experience. The control monkeys were about three months older when the mothers were attached to their cages than the experimental animals were when their mothers were removed and the retention tests begun. Thus, we do not know what the amount of contact would be for a 250-day-old animal raised from the start with surrogate mothers. Nevertheless, the magnitude of the differences and the fact that the contact-time curves for the mothered-from-birth infants had remained constant for almost 150 days suggest that early experience with the mother is a variable of measurable importance.

The control group has also been tested for differential visual exploration after the introduction of the cloth and wire mothers, and these behaviors are plotted in figure 17. By the second test session a high level of exploratory behavior has developed, and the responsiveness to the wire mother and the empty box is significantly greater than that to the cloth mother. This is probably not an artifact since there is every reason to believe that the face of the cloth mother is a fear stimulus to most monkeys that have not had extensive experience with this object during the first forty to sixty days of life. Within the third test session a sharp change in trend occurs, and the cloth mother is then more frequently viewed than the wire mother or the blank box, and this trend continues during the fourth session, producing a significant preference for the cloth mother.

Before the introduction of the mother surrogate into the home-cage situation only one of the four control monkeys had ever contacted the cloth mother in the open-field tests, and, in general, the surrogate mother not only gave the infants no security, but instead appeared to serve as a fear stimulus. The emotionality scores of these control subjects were slightly higher during the mother-present test sessions than during the mother-absent test sessions. In figure 18 the mean emotionality score for all the open-field tests given prior to the introduction of the surrogates to the home cage is compared with the mean of the fourth post-introduction test. In the absence of the cloth mothers the emotionality index in this fourth test remains near the earlier level, but the score is reduced by half when the mother is present, a result strikingly similar to that found

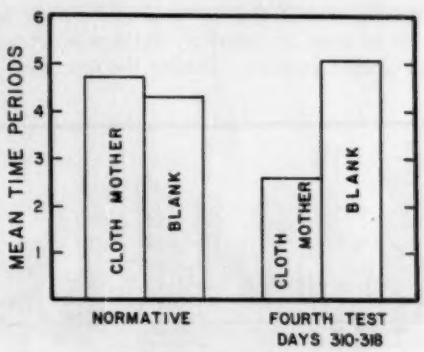


FIG. 18. Differential emotionality scores in open-field test for monkeys started at 250 days of age.

for infants raised with the dual mother surrogates from birth. The control infants now show increasing object exploration and play behavior, and they begin to use the mother as a base of operations as did the infants raised from birth with the mother surrogates. However, there are still definite differences in the behavior of the two groups. The control infants do not rush directly to the mother and clutch her violently, but instead they go toward, and orient around, her, usually after an initial period during which they frequently show disturbed behavior, exploratory behavior, or both.

That the control monkeys develop affection or love for the cloth mother when she is introduced into the cage at 250 days of age cannot be questioned. There is every reason to believe, however, that this interval of delay depresses the intensity of the affectional response level below that of the infant monkeys that were surrogate-mothered from birth onward. In interpreting these data it is well to remember that the control monkeys had continuous opportunity to observe and hear other monkeys housed in adjacent cages and that they had had limited opportunity to view and contact surrogate mothers in the test situations, even though they did not exploit the opportunities. Finally, it should be remembered that neither surrogate was a nursing mother.

The researches which we have presented here on the analysis of affectional variables and the nature of their development in monkeys are of necessity incomplete inasmuch as the program was initiated only a year ago and the investigations cited were planned as pilot studies outlining a broad research field. In spite of the limitations certain facts stand out in sharp relief: Multiple objective techniques, reliable and with apparent face validity, can be devised to measure the infant's affectional ties. Even an appropriate inanimate mother surrogate can readily become an object loved with intensity and for a long period of time. Satisfactory body contact is an extremely strong affectional variable and may well prove to be the most important affectional variable for primates.

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THE PREFACES TO THE GREEK EDITIONS AND LATIN TRANSLATIONS OF ALEXANDER OF APHRODISIAS, 1450 TO 1575

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THE present article is primarily a descriptive catalogue, using both quotation *in extenso* and summary, of the prefaces to the early modern Greek editions and Latin translations of Alexander of Aphrodisias. Its first purpose is to make the prefaces, which are often unpredictable in content and difficult to locate, more accessible to historical study, and it further attempts to suggest some of the points at which they illuminate the thought of their epoch. An index of names is appended which includes all contemporaries mentioned in the prefaces, together with very brief biographical and bibliographical information.[1]

A short account of the *fortuna* of Alexander may serve to place the prefaces in their historical context. Alexander flourished toward the end of the second century after Christ, and he quickly won a position of great authority in the late Greek and Byzantine philosophic tradition. Similarly in the Moslem world, his writings were early translated into Syriac and Arabic, and here too Alexander exercised an important influence on philosophic thought, notably through his interpretation of the Aristotelian doctrine of the intellect. In the Latin West, however, Alexander played no significant role during the late ancient and medieval periods. His works were not translated into Latin, and his very name was soon forgotten.

The twelfth and thirteenth centuries saw the first revival of interest in Alexander in the West. Toward the end of the twelfth century a group of shorter works, including the important *De intellectu*, were translated from the Arabic. Possibly in the twelfth, and certainly in the thirteenth century, the first translations made directly from the Greek appeared: 1. A chapter on fate from the *De anima*. 2. The *De fato*. 3. The *Commentaria in Aristotelis Librum de sensu*. 4. The *Commentaria in Aristotelis Meteorologica*. (It may be that there was also a translation of the Alexandrian or Pseudo-Alexandrian *Commentaria in Aristotelis Sophisticos elenchos*.) Aside from the *De intellectu*, these medieval translations attracted little attention, and in the fourteenth and early fifteenth centuries interest in Alexander slackened. After Peter of Abano translated the Pseudo-Alexandrian *Problemata* in 1302, there were no other translations until the version of the same work by Theodorus Gaza in 1453.

The second and more extensive revival of interest in Alexander developed during the latter part of the fifteenth century and continued well past the middle of the sixteenth century. The driving forces behind the revival were the new classical humanism and the new Renaissance philosophy. During this period the West came to possess both in Greek editions and in Latin translations virtually all the extant genuine and pseudonymous works of Alexander, and it is with the prefaces to these editions and translations that we are here concerned.

For the present article 1450 and 1575 have been taken as limiting dates. These serve particularly well for the translations. As already noted, Gaza's translation of the *Problemata* in 1453 is preceded by a century and a half of silence. Similarly there are no translations between 1573, when J. B. Rasarius published his *Commentaria in Aristotelis Topica*, and the end of the sixteenth century. The Greek editions are more closely grouped in time, between 1497 and 1536. There is in the sixteenth century only one later edition (the *De fato*, ed. Ioannes Caselius, Rostock, 1588), and it does not appear that this is usefully grouped with the earlier publications.

To look at the Greek editions first, all the works of Alexander (except the *Commentaria in*

[1] Much of the material for the present article was gathered in the course of the author's work on Alexander of Aphrodisias for the *Catalogus Translationum*, and readers are referred to the section on Alexander in the forthcoming *Catalogus* for further details on such matters as the *fortuna* of Alexander, the dates and editions of the various translations, etc. The author thanks Professor P. O. Kristeller for his generous assistance in the preparation of this article; it is notably better than it would have been without his help.

Aristotelis Metaphysica and the *De febribus*) appeared in Greek between 1497 and 1536. All were first published in Venice and, with a single exception, by the Aldine press. By 1575 there had been two editions of the *Commentaria in Aristotelis Topica* and of the *Commentaria in Aristotelis Sophisticos Elenchos*, three editions of the *De fato*. The main motive for the Greek editions seems to have been the zeal for Hellenic studies and the desire to make available in proper form all the "good authors," Greek as well as Latin.

The story of the Latin editions is longer and more complicated. From the period 1450 through 1575 there are extant some 44 whole or partial translations of Alexandrian works. Eleven of these exist only in manuscript. Of those printed, there are roughly one hundred known editions, some of which contain more than one work of Alexander.

Venice is the most important single center for the translations, as it had been for the editions, but within Italy, Florence, Milan, and Rome are also represented. Outside Italy, there are a few translations from France and one from Germany. In contrast to the editions, the translations show closer connections with contemporary intellectual developments. In general, where the background of the Greek editions is largely humanist and philological, that of the translations is more specifically philosophic.

What is to be said of the historical value of the prefaces to these Greek editions and Latin translations of Alexander of Aphrodisias?

It must first be noted that the prefaces do not constitute a unity which can be isolated and studied by itself; none of them supports the thesis that there existed a separate "Alexandrist" tradition. In part the prefaces must be related to the larger context of Renaissance Aristotelianism, in part to the still larger context of Renaissance humanism. Nevertheless, these larger developments are often illuminated by the evidence of the prefaces, which not only give us a broader basis for understanding the general movements of the time but which also add new material on points of detail.

The general position of the Alexander prefaces may be described as a conciliatory and universalist humanism. The authors regularly assume that all educated men are in agreement on fundamental truths, and they have surprisingly little to say of the bitter disputes of the Reformation and Counterreformation. They confidently assume a harmony between faith and reason, religion and philosophy, and in many cases they use Alexander to support Christian doctrine (IV,*b*,2; VI,*a*,1; VI,*b*,3; VII,*a*,1; VIII,*b*,2; VIII,*b*,4; XVII,*a*,1).[2] Likewise they assume that the great philosophers represent a basically united tradition, and, as we shall see, if most of them are Aristotelians, they are not anti-Platonists.

The exception to this generally conciliatory approach is the almost unanimous attack on the immediately preceding age as one of darkness and barbarism. Sometimes this appears as the description of a time in which philosophy and "good letters" were always at odds and in which no one could be accepted as learned unless he spoke bad Latin (I,*a*,1; I,*b*,2; IV,*b*,2; V,*b*,1; VI,*b*,3). Sometimes it appears as a vivid, though traditional, account of the neglect of good authors during a dark epoch when their manuscripts lay forgotten, dust-covered and worm-riddled (I,*a*,1; III,*a*,1; III,*a*,2; VII,*b*,6; VII,*b*,7; XII,*a*,1; XII,*b*,3). But if our authors delight to expand their rhetoric on the topics of barbarous Latin and dust-covered manuscripts, they no longer treat these dangers as very real, and they exhibit a strong sense of Renaissance triumph over preceding darkness. Barbarism has been almost completely wiped out, and the new education, based on good editions and good translations, will never permit it to return (I,*a*,1; IV,*b*,2; VII,*b*,7; XV,*a*,1).

Throughout the prefaces the authors regularly assume as audience a united body of educated men, and it is the common good of this group which encourages and justifies their labors of edition and translation. Among the editors, Aldus is the outstanding example of selfless dedication to the service of the *studiosi literarum*, but others emulate his ideals and repeat his words (I,*a*,1; III,*a*,2; VI,*a*,1; VII,*a*,1; XII,*a*,1; XVII,*a*,1). Similarly the translators labor for the common good of the *studiosi philosophiae* (VII,*b*,3; XII,*b*,4) or of the studiosi in general (I,*b*,2; III,*b*,2; VI,*b*,4; VI,*b*,5 etc.).

In their discussion of philosophy, as noted above, our authors again try to create an atmosphere of unity and harmony. Most of them may be classified as Aristotelians, and we find frequent praise of "the philosopher" and

[2] The numbers in parentheses refer to the prefaces described below. For the complete list, see p. 513.

of Alexander as his outstanding commentator (e.g., I,*b*,2; III,*b*,2; VII,*b*,6; XV,*b*,4). Nevertheless, Aristotle is exalted not so much as the author of a particular philosophic system but rather as the embodiment of wisdom and of philosophy in general. He and Plato, for example, are the "twin lights" (V,*b*,1), and to commend the one is not to denigrate the other (I,*b*,2). Similarly in their thumb-nail histories of philosophy, the authors of the prefaces show a generous willingness to recognize good thinking wherever it is found, whether among the barbarians and the Moslems or even among the pre-Greek civilizations (I,*b*,2; IV,*b*,2; VI,*b*,4; VII,*b*,3).

The general position of the prefaces may be described as a broad philosophic theism, combined with a special recognition of the importance of the "good letters" of Greece and Rome. There is little interest in technical philosophic debate, though we find a number of brief treatments of some broad topics of philosophy (e.g., III,*b*,2 on the art of reasoning; IV,*b*,2 on the senses; VII,*b*,6 on dialectic; VIII,*b*,2 and VIII,*b*,4 on fate; XV,*b*,4 on logic). By and large, our authors evidently feel that the most important teachings of philosophy are those broad moral and religious conclusions which command general agreement.

Our authors once more abandon their conciliatory approach whenever they touch on the philosophy of the "Middle Ages." They may recognize something of the acuteness of scholastic thought, but for the most part they condemn it out of hand as barbarous and trivial (IV,*b*,2; V,*b*,1; VI,*b*,3; VI,*b*,4. For a more sympathetic approach, see I,*b*,2).

The translators among our authors have a good deal to say of the theory of translation, and they show a keen awareness of the problems involved. In particular, they recognize the difficulty of translating philosophic Greek into a Latin which lacks the requisite vocabulary. In general, their aim is to combine accuracy with a good, if plain, style and to make use of a truly "Latin" vocabulary (I,*b*,2; IV,*b*,2; V,*b*,1; VII,*b*,6; IX,*b*,2; XII,*b*,1; XV,*b*,3; XV,*b*,4). As usual, the Middle Ages provide the foil for the virtues of our authors, and they frequently ridicule the scholastic method of word-for-word translation (e.g., IV,*b*,2; V,*b*,1; VI,*b*,3; VII,*b*,6; IX,*b*,2). On the other hand, many of the translators feel it necessary to defend their plain style against the criticisms of the grammarians and of the rhetoricians (e.g., V,*b*,1; IX,*b*,2; XII,*b*,1). We see indications of the emerging quarrel between philosophy and rhetoric, and most of our authors attempt somewhat uneasily to maintain a moderate middle position. They are sure the scholastics were wrong in completely sacrificing the principles of "grammar" and rhetoric; they are fearful of the Renaissance position which would make philosophic style completely subject to grammatical and rhetorical canons.

L. Philalthaeus occupies a special position, and he gives us an interesting account of his own development. In his early career as a translator he had shown little concern for good style. During a middle period, he attempted to improve the Latin of his versions but did not entirely break with the older tradition of philosophic translation with its Grecisms and its barbarisms. Finally, in his translation of Alexander he endeavors to be a pure Ciceronian, and he boasts that he uses no word not taken from Cicero himself. However, even Philalthaeus does not attempt to introduce Ciceronic periods (numeri), and he feels that he must defend himself against criticism on this account (IV,*b*,2).

The prefaces also contain the beginnings of a history of Renaissance translations and of the triumph over medieval barbarism in this field. Theodorus Gaza receives general recognition as the great innovator, and we also find mention of Ermolaus Barbarus, Hieronymus Donatus, and Marsilius Ficinus (I,*b*,2; V,*b*,1; VI,*b*,3). In general our authors do not look further than their hope for adequate Latin translations of all the good authors. Only Alexander Piccolomineus, in a statement typical of his general position, foresees a time when all these authors will also be available in the "Tuscan idiom" (VI,*b*,4).

In addition to such illumination of some of the general ideas and movements of the time, the prefaces offer a large amount of information on points of detail. Thus most of the translators and some of the editors tell us of the circumstances which led to the work, and here we can study the connections between a particular publication and the social or intellectual forces of the time. Further, there is a good deal of incidental biographical data, not only on editors and translators but also on the persons to whom the books were dedicated. Sometimes we learn of a special school or group such as the pupils of Georgius Valla (XVII,*b*,3), or of less formal

grouping such as those between Vincentius Madius and the Bagolini (XII,*b*,3) or the Piccolominei (VI,*b*,4), or of the courtly scholars at Florence in 1569 under Francis I (VII,*b*,6). Sometimes the prefaces give us new insights into contemporary opinions about thinkers such as Augustinus Niphus (III,*a*,2) or Jacobus Sadoletus (VI,*a*,1), or about patrons such as Clement VII (V,*b*,1), Nicolaus Rudolfus (XV,*b*,4), or Johannes de Lotharingia (XVII,*b*,5) or about significant military, political and ecclesiastical figures such as Gaspar Contarenus (I,*a*,1), Bernardus Salviatus (I,*b*,3), D. H. Mendozza (III,*b*,2), J. P. Saccus (IV,*b*,2), M. A. Venereus (VII,*b*,3), Philip II of Spain (VII,*b*,7), or Francis I of France (VIII,*b*,4). For a complete list of contemporaries mentioned in the prefaces, the reader is referred to the appended index of names.

In conclusion and summary, the prefaces to Alexander of Aphrodisias constitute a considerable body of source material on the ideas and men of their time. This material helps to illuminate a difficult period in intellectual and philosophic history when there are few, if any, dominating figures who can give organization and coherence to the story. Yet the thought of the time is far from being merely anarchy and transition. There are important forces of stability and continuity, and among the most significant of these is what may be called Renaissance traditionalism, a way of education and thought resting essentially on a humanist study and understanding of the "good authors." It is this traditionalism which our authors reflect and espouse, and they aid us in answering the crucial question: how and in what religious and moral context were the good authors read?

The writers of the prefaces are clearly not men of great originality or power, but they are just as clearly members of an educating and educated elite. They evidently shared to a notable extent a common approach and a common way of thinking. Traditionalists in the best sense of the word, they speak for a tradition which was socially and intellectually vital through the first part of the sixteenth century, and which only gradually lost ground thereafter. For a balanced understanding of their epoch, in which violent and bitter polemic often blind us to the larger continuities, the historian does well to make full use of the evidence of these prefaces and of others like them. The present catalogue is simply intended to make this more easily possible for the single case of Alexander of Aphrodisias.

The prefaces will be catalogued in the order of the *Catalogus translationum*; this is alphabetical, first for the genuine works of Alexander and second for the pseudonymous writings. For the sake of a better understanding of the place of these prefaces in the whole *corpus* of editions and translations, the following list is complete and contains also the medieval translations (none of which have prefaces) and the Renaissance editions and translations without prefaces.

I. *De anima*

a. Greek:

1. *Omina Themistii opera. Alexandri Aphrodisiensis libri duo De anima et De fato unus.* Venetiis, apud Aldum. 1534.

b. Translations:

1. Chapter *De fato* of *De anima* II. Anonymous, twelfth or thirteenth century. Manuscript only.

2. Book I only. Hieronymus Donatus, before 1495.

3. Book II only. Angelus Caninius Anglariensis, 1546.

4. Book I, partial. Antonius de Albertis, middle of sixteenth century. Manuscript only.

5. Chapter *De fato* of *De anima* II. Horatius Ursinus, toward middle of sixteenth century. No preface. Manuscript only.

II. *De augmento*

a. Greek: not extant.

b. Translations:

1. Gerardus Cremonensis, twelfth century. From the Arabic.

III. *Commentaria in Aristotelis Analytica priora*

a. Greek:

1. Venetiis, apud Aldum, 1520.

2. Florentiae, per haeredes P. Juntae, 1521 (a copy of the Aldine edition).

b. Translations:

1. Preface only of the *Commentaria*. Bartholomaeus Zambertus, 1511 and revised 1521 and 1524. No preface. Manuscript only.

2. Johannes Bernardus Felicinus, 1542.

IV. *Commentaria in Aristotelis Librum de sensu*

a. Greek:

1. *Simplicii Commentaria in tres libros Aristotelis De anima. Alexandri Aphrodisiei Commentaria in Librum de sensu et sensibili. Michaelis Ephesii Annotationes.* Venetiis, apud Aldum, 1527.

b. Translations:

1. Guillelmus de Moerbeka (?), second half of thirteenth century.
2. Lucillus Philalthaeus, 1544.

V. *Commentaria in Aristotelis Metaphysica*

a. Greek: no Renaissance edition.

b. Translations:

1. Johannes Genesius Sepulveda, 1527.
2. Partial translation of Book Mu (XIII). Anonymous, middle of sixteenth century (?). No preface. Manuscript only.

VI. *Commentaria in Aristotelis Meteorologica*

a. Greek:

1. Ioannes Grammaticus, *In libros de generatione et de interitu.* Alexander Aphrodisiensis *In Meteorologica.* idem *De Mixtione.* Venetiis, apud Aldum, 1527.

b. Translations:

1. Guillelmus de Moerbeka, 1260. Manuscript only.
2. Petrus Franciscus Portinarius, 1515. No preface. Manuscript only.
3. Partial. Ludovicus Nogarola, *ca.* 1536. Manuscript only.
4. Alexander Piccolomineus, 1540.
5. Johannes Camotius, 1556.

VII. *Commentaria in Aristotelis Topica*

a. Greek:

1. Venetiis, apud Aldum, 1513.

b. Translations:

1. Books I–IV only. Marcus Musurus, 1501–02. No preface. Manuscript only.
2. Bartholomaeus Zambertus, 1521. No preface. Manuscript only.
3. Guilelmus Dorotheus, 1540.
4. Anonymous, 1547. No preface.
5. Book VII only. Marcus Antonius Muretus, 1554.
6. Book III only. Petrus Gherardius, 1569.
7. Johannes Baptista Rasarius, 1573.

VIII. *De fato*

a. Greek:

1. With various Latin translations of Alexander by H. Bagolinus, Veronae, ab Andrea B.C., impendio interpretis, 1516. For connected preface, see VIII,*b*,2.
2. See I,*a*,1 above.
3. See XII,*a*,1 below.

b. Translations:

1. Anonymous, twelfth or thirteenth century. Manuscript only.
2. Hieronymus Bagolinus, 1516.
3. Hieronymus Bagolinus and Johannes Baptista Bagolinus, 1541 (?). No special preface, but see XII,*b*,3 below.
4. Gentianus Hervetus, 1544.

IX. *De intellectu* (= *De anima*, II ed. I. Bruns, p. 106–113)

a. Greek: see I,*a*,1 above.

b. Translations:

1. Gerardus Cremonensis (?), twelfth century. From the Arabic.
2. Hieronymus Bagolinus, before 1516.

X. *De mixtione*

a. Greek:

1. See VI,*a*,1 above.

b. Translations:

1. Jacobus Scheckius, 1540. No preface.
2. Angelus Caninius Anglariensis, 1546. For preface, see I,*b*,3 above.
3. Gaspar Gabriel, before 1553. No preface. Manuscript only.

XI. *De motu et tempore*

a. Greek: not extant.

b. Translation:

1. Gerardus Cremonensis, twelfth century. From the Arabic.

XII. *Quaestiones naturales et morales*

a. Greek:

1. *Quaestiones Alexandri Aphrodisiensis naturales, de anima, morales. Metaphrasis ex Damascio in primum librum De coelo et mundo. . . .* Venetiis, B. Zanetti, 1536. (The copies known to me contain sometimes only the *Quaestiones* of Alexander, sometimes only the *Quaestiones* and the *De fato*.)

b. Translations:

1. Selections only. Hieronymus Bagolinus, 1516.
2. Books I–III only. Hieronymus Bagolinus (?), 1516 (?). No preface. Manuscript only.
3. Hieronymus Bagolinus and Johannes Baptista Bagolinus, 1541.
4. Gentianus Hervetus, 1547.

XIII. *De sensu et sensato*

a. Greek: not extant.

b. Translation:

1. Gerardus Cremonensis, twelfth century. From the Arabic.

XIV. *Commentaria in Aristotelis Analyticorum Posteriorum Librum II*

a. Greek:

1. Printed under the accepted ascription to Eustratius, along with the *Commentaria* of Ioannes Philoponus, Venetiis, apud Aldum, 1534.

b. Translation:

1. Andreas Gratiolus, 1542. No preface. In the first edition, Venetiis, apud Scotum, 1542, the *Commentaria* are ascribed, as in the Greek edition, to Eustratius. In the second edition, Venetiis, apud H. Scotum, 1568, they are titled: *Alexandri Afrodisei et Eustratii episcopi Nicaeni Commentaria in II librum Posteriorum Resolutivorum Aristotelis*.

XV. *Commentaria in Aristotelis Sophisticos elenchos*

a. Greek:

1. Venetis, apud Aldum, 1520.
2. Florentiae, per haeredes P. Juntae, 1521 (a copy of the Aldine edition). No preface.

b. Translations:

1. Bartholomaeus Zambertus, 1524. No preface. Manuscript only.
2. Guilelmus Dorotheus, 1541.
3. Johannes Nabascuensis, 1542.
4. Gaspar Marcellus, 1546.
5. Johannes Baptista Rasarius, 1557.

XVI. *De febribus*

a. Greek: no Renaissance edition.
b. Translation:

1. Georgius Valla, before 1498.

XVII. *Problemata*

a. Greek:

1. In Vol. III of Aristoteles, *Opera*, apud Aldum, 1495–98.
2. See *b*,5 below.

b. Translations:

1. Petrus Padubanensis, 1302. Manuscript only.
2. Theodorus Gaza, 1453.
3. Georgius Valla, 1488.
4. Angelus Politianus, 1478.
5. Johannes Davionus, 1540.

In the catalogue, a few of the shorter prefaces will be cited in full, but most will be described through a combination of quotation and summary. In choosing the passages for full quotation, I have tried to include: (1) all material bearing on the circumstances and motives which led to the edition or translation in question; (2) all accounts of the history and method of edition and translation; (3) all discussions, when not too lengthy, of the history and problems of philosophy. In addition, I have included a few passages which seem of particular interest for the history of the time.

In the text of the prefaces, the spelling has been standardized and minor typographical errors have been corrected without notice. Where I have emended the text, the original reading is added within brackets; where the text is doubtful but the proper emendation not certain, I have indicated this by a question mark in parentheses.

The summaries indicate the contents of the omitted sections and give approximate lengths; the names of any contemporaries mentioned in the text are taken into the summaries.

I,*a*,1. *Omnia Themistii opera. Alexandri Aphrodisiensis libri duo De anima et De fato unus.* Venetiis, apud Aldum, 1533.

Only one preface for whole book.

Gaspari Contareno Senatori Optimo et Clarissimo, Victor Trincavallus Medicus SS.

Cum praeclara illa et celebris Aldi Manutii officina, quae sempter bonorum librorum elegantem supellectilem viris studiosis ut copiose ita feliciter sumministravit, magnifice et clarissime Gaspar, ob varias eius morte, et mox Andreae Asulani soceri, ut fit, subortas perturbationes, non sine maxima literatorum omnium iactura, aliquot annis fere destituta, atque, ut ita dixerim, iam clausa esset, suis tandem rebus compositis eorum filii, ne a parentibus viris optimis, quibusque studiosi omnes maxime debent, degenerasse unquam videantur, eam aperire, ac etiam quoquo modo possint, clariorem reddere decreverunt. [They asked Trincavallus to edit Themistius, and he agreed, though he had almost deserted philosophy for medicine, because he was aware of the debt of all scholars to the Aldine family. 250 wds.] Superioribus enim saeculis inter alias Italiae calamitates tetra quaedam turpisque barbaries in hominum ingenia irruperat, tantamque exercebat tyrannidem, ut si quis literarum bonarum lumen vel procul ac veluti de nube prospiceret, is statim ab omnibus reiiceretur tanquam inutilis, et ad studia philosophiae, medicinae, caeterarumque disciplinarum liberalium ineptus, ita ut necesse huic esset qui nomen aliquod aut authoritatem vellet in publicis gymnasiis consequi, solam affectare barbariem. Doctior enim ille habebatur, qui magis ineptiret. Quod si quis reperiebatur, qui hanc ingeniorum calamitatem miseratus herculeo animo immanem illam beluam aggredi et confodere temptaret, illi statim erat succumbendum, et si enim satis fortasse virium ingeniique habebat, arma tamen deerant, quibus posset prosterni ac iugulari, cum multa bonorum authorum volumina temporum calamitate ac iniuria periissent, multa carie corrosa, pulvere situque obsita ac semiputrida laterent, innumera etiam mutila, et mendis fere infinitis scatentia circumferrentur, ut vix amplius sperandum esset, posse bonarum literarum studia revirescere aut reflorescere. Id quod animadvertens Aldus, numquam satis de hac re laudandus, ad ea erigenda, fovenda, et augenda vires omnes, animumque primus omnium intendit, et statim magnis laboribus, summaque industria nec minore sumptu optimos quoque libros ubique conquisitos, et qua poterat maiori diligentia variis invicem collatis exemplaribus castigatos, pulcherrimis caracteribus excusos, ut vel hac ratione ad legendum homines invitaret, publicandos quotidie curavit. Unde tantum rei literariae attulit auxilii, ut continuo insolens illa ineptaque barbaries explooderetur, factumque est, ut nunc non nostris solum, sed barbaris etiam ipsis coeperit esse exosa. [Hence Trincavallus would have been ungrateful to decline their request, and he has with great labor finished the edition of Themistius and also of Alexander, *De anima* and *De facto*. He concludes with the praise of Contarenus who, like Themistius, combined the virtues of a philosopher with those of a statesman. 400 wds.]

I,*b*,2. *De anima* I, translated by Hieronymus Donatus. Here quoted from the first edition, Brixiae, opera Bernardini de Misentis de Papia, 1495. A partial reprint of the Preface, from the edition, Venetiis, apud H. Scotum, 1549, may be found in E. Garin, *Filosofi italiani del Quattrocento* (Firenze, 1942) p. 539–541.

Praefatio: Aristotelem philosophum ita ab initio antiquitas admirata est, ut eum laudaret potius quam sectaretur. Nam et in Graecia et in Italia diu Platonem secuti sunt, ambitione et pompa maiore quam studio, quod et carminibus et dialogis et affectatis translationibus rerum naturae traditione proposita delectabantur. Quam docendi rationem iam per ea tempora receptam, cum velut a philosophiae gravitate et simplicitate alienam omnino repudiasset Aristoteles, difficilior et pressior iisdem temporibus visus est. Sed cum in disponenda doctrinarum institutione mire doctus et Atticus, tum in incessendis antiquis philosophis assidue et feliciter pertinax, philosophiae tandem apud posteros principatum obtinuit, ut multis iam saeculis longe plures sub Aristotele quam sub Platone profecisse videantur, non quod Aristoteles doctior fuerit, Plato indoctior. Superstitiosae enim scientiae est eos invicem comparare, a quibus discere magis convenit. Utrique summi extitere et divina quadam providentia alendis et instituendis ingeniis accommodati. Verum monumenta quae sequeremur, quibusque institueremur, plura et distinctiora reliquit Aristoteles, in cuius libris, non alio fere contextu rerum naturae scientia proposita est, quam quo

res ipsae constant et generantur. Quod vulgata iam illa in omnes Aristotelis libros, et a Graecis auctoribus sumpta divisio, plane commonstrat. Aristoteli Theophrastus et Eudemus, et alii complures ex Peripateticis adhaesere, eiusque libros interpretati sunt, et diu quidem maiore ipsorum gloria quam addiscentium utilitate. Verum multis post saeculis Alexandro Aphrodiseo sub divis Severo et Antonino imperatoribus philosophiam profitente, ita Aristotelis et Peripateticorum nomen increbuit, ut tunc primum non iam Aristoteles, sed Philosophus duntaxat vocaretur. Neque item dignus hoc philosophiae nomine censeretur qui non ex Alexandri officina prodisset, et satis tituli et aestimationis haberet, qui Alexandreus nuncupari meruisset. Inter quos fuere Themistius, Ammonius, Simplicius, Philoponus, Olympiodorus aliique permulti.

Post quos, Graecia ante dilapidata, et Roma atque Italia diruta, pessum simul iverunt bonae literae, expugnataeque a barbaris, ad barbaros se receperunt. Namque apud Mauritianos, qui non tam Cordubam in Bethica, quam universas ferme Hispanias occupabant, philosophiae et medicinae studia viguere, iique Aristotelem et Alexandrum, Hippocratem et Galenum cum optimis quibusque Graecis interpretatoribus, suo idiomate suos effecerunt. Quo factum est, ut doctus et excellens quidem nidor ex eorum culina ad nos usque pervenit, in qua permulti summo ingenio et pari doctrina praestantissimi evasere. Ex quibus satis sit Avicennam inter medicos, Averroim inter philosophos enumerasse. Ille ex Graecis medicis maxime, quae ad spectativam iatrices partem pertinent, fere in unum redegit omnia. Hic ex Graecis enarratoribus eos, et sequi et incessere delectatus, velut ex optimis fontibus, philosophiam visus est non tam hausisse quam expressisse, cum solus is fuerit qui Commentatoris nomen adeptus sit. Tantum est sequi bonos auctores et ex agro fertili messem facere. Fere qui Averroim exacte legerit, et suis quaeque locis singulatim singula contulerit, eius doctrinam ab optimis auctoribus prodisse comperiet. In eius enim interpretationibus, Alexandrum, Themistium, et Simplicium licet videre diversa linguae proprietate, paraphrasi quadam expressos, et dictis, opinionibus, sententiis (ubi egregie quid dicitur) ferme eosdem.

Recentiores proximioribus saeculis in Britannia et Galliis, atque Italia, religionibus addicti, magis ex religione quam ex Aristotelis doctrina, acutissime philosophati sunt, et qua parte Aristotelem secuti sunt, omnia complevere non tam interpretationibus quam titillantibus argutiis, quippe qui per cavillamenta, et quaestiunculas philosophiam tradidere, ut ambitiosa et praepostera quadam consuetudine prius disputare quam discere incipiant. Caeterum alios (ut se quisque opinioni addixit) alia studia delectant; alii eos qui philosophiam abdicatis bonis literis professi sunt, stomachantur et detestantur neque dignos putant, qui vix inspici aut legi debeant. Alii philosophiam ita inimicam bonis literis censent, ut etiam soloecismos et barbarismos affectent, et in auctoritatem scientiae proferant. Ita tumultuatur humanum genus, et interdum vel in ipso inani gestit et fluctuat. Sed meo quidem iudicio, hominis vere philosophantis est praestare prudentiam, non umbram sed corpus amplecti, rerum scientiam, sive inter Latinos, sive inter Graecos, sive inter barbaros sic amore et studio prosequi, et repudiatis abiectisque corticibus, nucleos degustare. Atqui cum vitio temporum liberalia studia plerique sequamur, alii ut discamus, alii ut discere videamur, tantum sciat qui Alexandrum legerit, se nihil inanis, ac vento quodam turgidae ostentationis, sed meros philosophiae succos imbibiturum.

Ego cum enarrationem eius De anima in manus desumpsissem, legendi potius quam interpretandi gratia, ex nostro senatu apud Mediolanenses principes legatum agens: quantum per occupationes publicas licuit curavi, ut simul in otio honestissimo versarer, simul qua parte possem, liberalibus ingeniis subinde prodessem. Itaque eam maiore interpretationis fide quam eloquentiae ambitu, ut a nostris legi posset, Latinam feci. Boni consulant, qui legent, si ea quae ad philosophiam pertinent, simplicius quam elegantius versa cognoscent. Non est haec exercitatio vel eruditis omnino facilis, neque alias in vertendis rerum naturae traditionibus, haec in plerisque felix audacia est, tametsi eam praeclare attigerunt aevo nostro Theodorus Gaza, et Hermolaus Barbarus, viri omni doctrinarum et morum laude cumulatissimi. Librum hunc esse Alexandri non tam inscriptio quam stylus, et citatae a posterioribus, praesertim ab Averroi, particulae fidem faciunt. Cuius interpretatio in partem dicata est nemini, in universum iis dicata sit, qui eam legendam duxerint. Id dumtaxat ex hoc labore mercedis et gloriae mihi postulo, si quid quenquam inter legendum offenderit, non auctorem accuset, sed interpretem.

I,*b*,3. *De anima*, Book II, translated by Angelus Caninius Anglariensis. Here quoted from the first edition, 1546, Venetiis, apud H. Scotum.

Illustrissimo ac Reverendo Domino Bernardo Salviato, Priori Romano Dignissimo, Angelus Caninius Anglariensis S.P.D.

Superioribis diebus quorundam meorum amicorum hortatu Alexandri Aphrodisiensis secundum librum *De anima* una cum libello *De mixtione* in Latinam linguam converti, qui meorum studiorum primus fructus in publicum emersit. [Caninius dedicates it to Salviatus, who combines military capabilities with love of philosophy and of letters. 275 wds.]

I,*b*,4. *De anima*, partial translation of Book I by Antonius de Albertis. The translation exists only in the author's working copy, Wien, Österreichische Nationalbibliothek, Cod. 10.487.

Lectori.

[If you desire knowledge of all things, read this book about the soul, for the soul in some way *is* all things. 50 wds.]

III,*a*,1. *Alexandri Aphrodisiensis, In Priora analytica Aristotelis Commentaria*. Venetiis, apud Aldum, 1520.

Franciscus Asulanus Nicolao Passero de Ianua, optimo bonarum artium parenti, S.D.

[Franciscus praises doctors, and Nicolaus in particular, who a few days previously cured him of a severe fever. It would deserve even more honor if anyone could bring the dead to life. 200 wds.] Quae si ita sunt, Nicolae parens honorate, non modicum et laudis et gloriae, non temere non arroganter sed aequissimo mihi iure assumere posse videor, nam cum opacis in tartarorum tenebris, Alexandrum in Priora Philosophi analytica, pallenti confectum squalore, taetra exesum rubigine, frequentibus hinc inde confossum vulneribus, miseros passim laniatum foedatumque artus, quin et iam omni prorsus sensu vitaque carentem offenderim, hunc lachrymis miseratus obortis, de imo herculeis adnixus viribus extraxi orco. quem miserum ut iniqua adeo deformatum conspexi sorte, non potui non acerbius deflere, quin et meas omnino partes esse duxi (sic enim et fas et pium cogebant) ut tantopere pro summis elaborarem viribus, quoad mea ipsius opera, superas iterum Alexander reviseret auras, et in suum reviviscens reverteretur corpus. [Franciscus continues with the medical metaphor: finally, Alexander lives. He sends him to Nicolaus who should protect him and who may read him in the intervals of his divinity studies. Further Nicolaus' son Marcus Antonius will be educated by him. 450 wds.]

III,*a*,2. *Alexandri Aphrodisiensis in Priora analytica Aristotelis commentaria*, Florentiae, per haeredes Philippi Iuntae, 1521. Most of the preface is reprinted in A. M. Bandinius, *De Florentina Iuntarum Typographia*, 2 parts, Lucae, 1791, Part II, p. 172–174.

Augustino Nipho de Medicis Suessano, Peripateticorum Principi, Antonius Francinus Varchiensis, felicitatem.

Nihil est, meo quidem iudicio, Augustine praestantantissime, magis hominis proprium, et quod illum magis Deo similem reddat, quam cum possis prodesse quamplurimis. Hoc autem multis, et illis validissimis argumentis, quod non ignoras, confirmari posset, ex quibus illud nobis dixisse satis sit, quod saepissime dicere solebat, et paulo antequam ex hac vita migraret [migrat], nobis dixit Marcellus Virgilius, Secretarius Florentinus, orbis lumen, Italiae decus, urbis Florentinae ornamentum, cui tantum credebamus, quantum antiquitas credere solebat illi, qui Apollinis oraculo sapientissimus est iudicatus: tibi ceterisque cum potes, prodesse non desinas. Adde, quod hinc Platonem, hinc Aristotelem, hinc te ipsum huius felicissimum interpretem, ut alios omittam, tam multa monumentis literarum demandasse affirmaverim, ad communem scilicet omnium *τῶν ὄντων καὶ τῶν ἐσομένων* utilitatem. Nos vero ne illis, quae in ceteris probamus, defuisse videamur, olim, quoad potuimus, optimos quosque tum Graecos, tum Latinos auctores, laceros, mutilos, suis numeris perturbatos, nostris lucubrationibus, collatis in unum multis antiquissimis exemplaribus, nisi ad pristinam integritatem redactos (non enim hoc dixisse ausim) at saltem meliores factos excudendo, studiosis profuimus, et adhuc prodesse cogitamus. Nam cum omnes fere poetas, oratores, historiarumque scriptores excuserimus, nos ad dialecticem convertimus, mox ethicem, physicemque adgressuri, si Dii coeptis nostris aspiraverint; est namque in animo Aristotelis omnia opera a Marcello Vergilio olim castigata, in lucem edere. Nuper autem *Ἀλεξάνδρου τοῦ*

'Αφροδισέως de quo multa dicenda forent, quae ne in hac nostra praefatione longiores simus omittimus, εἰς τὰ τοῦ 'Αριστοτέλους Πρότερα ἀναλυτικὰ ὑπόμνημα excusimus, tuisque felicissimis auspiciis in lucem prodire volumus, non quia te interprete indigere credamus, sed ut interpres sub interpretis tutela, felicius in vulgus prodeat.

Praetero iudicii tui gravitatem, ingenii magnitudinem, egregiam Latinae Graecaeque linguae eruditionem, tum qui haec omnibus nota sunt, tum quia hae tuae laudes maiori praeconio celebrandae forent; ut iure optimo Leo Pontifex Maximus acerrimus ingeniorum pensitator et iudex, te familiae suae cognomine donatum voluerit. Suscipe ergo laeta fronte munusculum hoc nostrum, et de Antonio Varchiensi numquam a te viso, tantum tibi pollicearis, quantum de amicorum optimo. Vale, longumque tibi, et ceteris literarum amatoribus vive.

III,*b*,2. *Commentaria in Aristotelis Analytica priora.* Translation by Johannes Bernardus Felicianus, here cited from the first edition: Venetiis, apud Scotum, 1542.

Clarissimo atque illustrissimo Diego Hurtado Mendozzae Caesaris Oratorem apud Venetos agenti, Ioannes Bernardus Felicianus S.

In iis omnibus, Mendozza clarissime, quae rationis particeps homo humano generi utiliter excogitavit, nihil mihi vel praestantius vel admirabilius videri solet, quam quod artes ac disciplinas invenerit, quibus ratio ipsa excoleretur. [If man's reason is not properly trained, he becomes even worse than the animals. Not without God's help did those divine men, the philosophers such as Plato and Aristotle, develop and teach mankind the art of reason. This art is useful for contemplation but even more important for action. 700 wds.] Ut gloriandum homini minime mihi esse videatur, quod a natura rationem fuerit adeptus, nisi studio et industria sibi eam excitarit et exercuerit, tam praeclaraeque artis subsidium comparare sibi non neglexerit. Haec ego cum saepe mecum cogitarem, non ab re me facturum esse existimabam, si Priorum resolutoriorum Aristotelis libro, quae facultatis huius de qua loquimur pars praecipua est, nonnihil operae impendissem. Nam licet demonstratio quae necessaria ratiocinatio est, finis eius sit, quia tamen ea raro admodum reperitur, et pauca in rebus humanis inveniuntur, quae eam admittant, non absurdum videtur, si utilitatis atque usus habita ratione, praecipuam eius partem eam esse censeamus, quae de ratiocinationibus agit, praesertim cum ita exquisite agat, ut rationum quasi normas quasdam nobis tradat, atque praescribat, ad quas et eas quae nos constituerimus, et eas quas ex aliorum vel scriptis vel disputationibus exceperimus ratiocinationes, bonaene sint, ac verae necne, quasi ad examen redigere ac perpendere valeamus, nihilque vel minimum in ipsis sit, quod sive ex conditione sive ex demonstratione agatur, vel latere nos queat, si ab aliis usurpetur, vel si nobis tractanda res sit, statim non suppetat. Quocirca Alexandri Aphrodisiensis in eum librum explanationes ad studiosorum commodum Latinitate donare conatus sum, ut eius artis quae praestantissima est, et rationabilibus hominibus perquam necessaria, pars praecipua atque utilissima, ab eo philosopho tractata, Aristotelem dico, qui consensu omnium longe melius atque exactius quam quisque veterum scriptorum eam distinxit atque explanavit, eius quoque explanatione illustrata a Latinis haberetur, qui peripateticae disciplinae interpres gravissimus atque optimus inter graecos iudicatus est. [Felicianus praises Mendozza for his family. He is dear to Caesar and undertakes important missions for him; a few years earlier he saved Venice from a severe famine by importing grain from Apulia. Further, he knows letters as well as if they were his only concern. 600 wds.]

IV,*a*,1. *Simplicii Commentaria in tres libros Aristotelis De anima. Alexandri Aphrodisiei Commentaria in Librum de sensu et sensibili. Michaelis Ephesii Annotationes* .... Venetiis, apud Aldum, 1527.

Francescus Asulanus Alexandro Campegio Bononiae Episcopo designato S.P.D.

Ex maximis meis laboribus, quos librorum copia bonorum suppeditanda capio: fructus eo uberiores ac iucundiores ferre consuevi: quo plures video excellenti ingenio, egregia voluntate nobiles adulescentes, optimarum artium studiis deditos, non ipsos solos curare ea, quae sunt omnium amplissima, sed ceteros quoque sui imitatione accendere: ut inventa veterum de natura, de moribus, de omni genere disciplinae persequantur. [Francescus has also gained the friendship of many, and he hopes to gain that of Alexander Campegius by the editing of these writings of Simplicius, Alexander of Aphrodisias, and of Michael of Ephesus. 250 words.]

IV,*b*,2. *Commentaria in Aristotelis Librum de sensu.* Translation of Lucillus Philalthaeus, here quoted from the first edition, Venetiis, apud Hieronymum Scotum, 1544.

Iacobo Philippo Sacco Excellentissimo Senatus Mediolanensis Praesidi Lucillus Philalthaeus S.P.D.

Postquam praeclara illa sapientiae studia, quae homine nobili et excellenti digna essent, apud Chaldaeos florere coeperunt, ad unum numen omnino antea incognitum eius generis homines brevi pervenisse receptum est, quos cum Aegyptii primum, Graeci deinde opibus, armis, imperio superassent, sese ad ea ipsa studia contulerunt. Nam multi eo tempore mortales quamquam rerum divinarum magnitudine perterriti essent, duce tamen philosophia cum ea quidem parte, quae bene beateque vivendi praecepta traderet, tum vero altera in perquirendis naturae initiis et rerum causis posita et constituta, ausi sunt in coelum usque penetrare, isticque pene omnia studiose conquirere, ubi tandem universi parentem ac rerum omnium architectum invenerunt. Quo in loco, ac beatorum domicilio cum multa praeterea et admirabilia ingenii rationisque acie quasi oculis collustrassent ceteris hominibus aut forte opinionis aut gloriae apud mortales comparandae studio vehemeter incensi haec ipsa interpretari vel monimentis literarum consignare ingressi sunt, unde omnis humanarum divinarumque rerum cognitio manavit ad posteros, et nos tantum sumus ipsi beneficium vel munus Deorum consecuti. Verum id sane ipsum non prius nobis dii immortales dederunt, quam ea in humano corpore instrumenta fecissent et in animo posuissent et collocassent ingenium, quibus coelum et reliqua ornamenta naturae non alteri quam homini aspectabilia egregie suspiceremus et studiosissime admiraremur. [Philalthaeus notices man's special posture, and he then goes on to praise man's senses at length; in the course of the discussion he makes full use of the ancient philosophic tradition on the importance of the senses. 1200 wds.] De quibus (sc. sensibus) nec a Platone, pluribus in locis, nec a Zenone, nec ab Epicuro tantopere elaboratum fuisset, nec diligentissime ab Aristotele libro praesertim secundo *De anima* et hoc separatim opusculo tanta nec subtiliter multa tractarentur, nisi laudibiles essent. Hoc autem, (ut scias tandem, Excellentiss. Praeses, quo mea referatur oratio) nuper (ut opinor) a me Latinis literis illustratum, dico sane Alexandri commentarium (etsi una Aristotelem Latinum feci, antea citra delectum verborum a multis in Latinum conversum) mecum ipse statui, ut in tuo illustri nomine appareret. [Philalthaeus praises Sacco's family and Sacco himself, who through his studies, particularly in civil law, had won the respect of Duke Franciscus Sfortia. Philalthaeus had recently been encouraged to dedicate the translation to Sacco by Franciscus Petronigra, a secretary of the Milanese Senate. He continues with an attack on the hasty and ignorant writings of his contemporaries. 750 wds.]

Redeo unde fluxit oratio. Opusculum hoc ab Aristotele elucubratum Graece commentariumque Alexandri a me Latine factum tibi, quem longa vita ususque rerum maxime ornavit et illustravit, inscribenda esse duxi, ut praeter alias, quas enumeravi causas, a me nuper institutum interpretandi genus degustes. Etenim cum aliquot ante annos in vertendis Graecis Aristotelis interpretibus multa e manibus meis vel exciderint vel elapsa fuerint nullo tum adhibito scribendi delectu, nulloque suscepta verborum artificio, coepi hortatu quam sane gravissimo Ioannis Baptistae Speciani, cuius consilium et fides domi militiaeque magnopere probatur, aliquanto politioribus verbis meam temperare orationem, quae Graeca praesertim illustratura esset. Nam etsi paulo limatius (ut est facile inque promptu videre) Graecos Aristotelis interpretes in Latinum converti, quam usus vel schola philosophorum patiebatur, tamen id citra delectum feci, atque nimirum ita, ut nulla a me sit longa inchoata oratio, vel perobscura, in qua verbum non legatur barbarum aut cum Latino saepe coniunctum, aut omnino solitarium, quod tum mihi faciendum duabus de causis censui, altera quidem, ut qui ex impolitis tenebricosisque philosophi interpretibus ad hos Graecos, qui magnum lumen Aristoteli attulerunt, sese traducerent, paulatim gradatimve perpolitis et melioribus literis assuescerent, ne cum hi ex diuturnis tenebris in amplum lumen erumperent, continuo luce obruerentur, veluti qui aliquanto solem intuiti vix, vel aegre, cetera cernunt; altera vero, ne perdifficiles sensus quodam verborum lenocinio, certisque orationis pigmentis, sive fuco puerili obscurarentur, minusque explicarentur ornatioribus lectissimisque verbis quam rudioribus, et barbaris, receptis tamen schola et impolitorum philosophorum usu.

At vero nunc mutavi sententiam hortante saepe (ut dixi) Ioanne Baptista Spetiano (?),

quocum tibi primum quaedam affinitas intercedit, deinde studiorum, et partium magna coniunctio, et nunc primum in hoc libro fateor a me diligenter animadversum observatumque magnopere, ne verbum quidem usurparetur, quod a Cicerone non exhaustum depromptumque fuisse videatur. Proinde laboravi cura studioque magno, ut quibus ipse cumque singulis verbis Graecis Latina quaeque singula reddere nequirem, circuitu verborum interdum meoque scribendi arbitratu quod uterque vellet et Aristo. et Alexan., exprimerem. Parum enim referre putavi, modo sententias utriusque explicassem, a me verba sumi, quae Latinitatem et leporem aliquem redolerent. Sed orationis numeros, quibus usus est Cicero divinitus, singulis locis inserere non potui, quod qui conantur assequi, a nescio qua levitate permoti me quidem hercule nesciunt, quid inter res scriptionesque forenses et philosophicas intersit, de quibus fortasse libro separatim uberius et luculentius disseram. Sed cur statuerim mihi potissimum Ciceronem deligendum esse, qui suis verbis Graecum hoc sane bellum perque utile opusculum illustraret, ea nimirum causa est, ut ostenderem qua via Graeca possent Latinis literis cum magno verborum delectu explicari ac dici fortasse elegantius quam barbari opinantur, vel etiam, ut eam philosophiae maiestatem et gloriam, iam prope senescentem quantum ego possem a barbarie et omnino ab impolito sermone vindicarem.

Simul enim ac primum in Italia publice Aristotelis scientia doceri coepit, in ipsum impolitorum hominum genus incidit; nuper vero devenit in medium rerum omnium discrimen, quo tempore humana et divina perturbantur et permiscentur adeo, ut nullus huic iam reliquarum artium duci locus relinquatur. Quare cum illa Latinitatis gloria florere potuit, his maxime hominibus caruit, qui in philosophia quemcunque cadere possent, verbis Latinis quam barbaris interpretari maluissent. Nunc vero iis obiecta est fluctibus, communibusque temporum casibus agitata, quibus religio nostra et magnis bellorum ardoribus et depravatis improborum opinionibus, vel indies etiam atque etiam laceratur et pervertitur. Verum quia divinitas eius tanta est, ut quemadmodum innumerabilibus ante saeculis semper floruit, ita in posterum semper in mentibus hominum duratura sit, huic illud ab omnibus deberi censeo, ut etiam nunc in his intestinis et gravissimis bellis, magnopere excolatur, et observetur, pro sua quisque parte [par] opem ferat. Quod tu pro tua hoc tempore praesertim facias velim, quo paene renasci politiores literae videntur. Bene et diu vale.

V,*b*,1. *Commentaria in Aristotelis Metaphysica.* Translation by Johannes Genesius Sepulveda, first published in 1527, Romae, M. Silber, here quoted from the edition Parisiis, apud Simonem Colinaeum, 1536.

Ad Clementem Septimum Pontificem Maximum Ioannis Genesii Sepulvedae Cordubensis praefatio.

Vetus querela est, Clemens septime, Pont. Max., et ea nec imprudentium hominum, nec ineruditorum, quidnam sit causae demirantium cur cum Aristotelem et Platonem summos philosophos, ac omnis philosophiae quasi parentes, antiquitas fuerit velut duo lumina venerata, nemo tamen in tanta virorum Graece et Latine doctissimorum copia, felicibus illis eloquentiae Romanae temporibus, extiterit, qui horum scripta divina, Latinis hominibus, illi aetati convenienti stilo ac perinde fideli prodere curaret cum Marcum Tullium Platonis studiosissimum fuisse constet, et Aristotelica non neglegenter, ut ipse profitetur, nec leviter attigisse, Brutum multos de philosophia libros edidisse, plures Marcum Varronem, qui habitus est Romanorum doctissimus, ut ceteri, qui non pauci connumerari poterant, taceantur. [But translation is very difficult and no way to win fame. 175 wds.] Tot igitur tantisque difficultatibus ab hoc scribendi genere studia hominum deterrentibus, duo principes philosophorum tam diu Latina interpretatione caruerunt, donec ex tua, id est Medicum familia extitere viri ut omnis virtutis colentissimi sic rei literariae percupidi, qui liberalitate sua literis, quae iam pridem iacebant, excitatis auctores fuere, ut viri utriusque linguae atque philosophiae doctissimi, nullo discrimine, nullo labore retardati, provinciam illam difficillimam obirent. Tuorum enim maiorum voluntate Marsilius Ficinus Platonis opera doctissime convertit. Ioannes Argyropylus Aristotelis magnam partem commode, nec ineleganter est interpretatus, cum antea nulla eius esset interpretatio, quae quidem tali nomine censeri mereretur, praeterquam in opere *De natura et generatione animalium* et *Problematis*, quos libros Theodorus Gaza ad Nicolaum Quintum luculentissime ac felicissime fuerat interpretatus. Quorum reliquias nos, quamquam non simus cum illis comparandi, pro

nostri tamen ingenii exiguitate, quoad licuit, sumus, dum tibi rem gratam facere cuperemus, persecuti. Sed quorsum haec tam multa de Aristotele eiusque latina interpretatione? ut desinas, pater clementissime, tu quoque, cuius voluntate et auspiciis Commentaria convertimus Alexandri Aphrodisiei in duodecim Aristotelis libros de prima philosophia, aliquando mirari, id quod tibi, dum mihi negotium iniungeres, mirum videri professus es, quod operis tam laudati, tantique auctoris hactenus interpretatio latina fuerit desiderata; cum illud magis sit admirandum, quod opus tam arduum, tot difficultatibus implicatum, aliquem, cuius auspiciis converteretur, invenerit aliquando.

Nam licet quamplurimi extitissent, qui certe perpauci omni memoria fuere, qui huiusmodi officium Latinis philosophis praestare potuissent, idest qui utriusque linguae peritiam cum philosophiae congnitione coniunxissent, quis tamen infinitum laborem suscepisset ultro, aut susceptum non saepe difficultatibus succumbens deseruisset, nullo velut numine ad opus adhortante, cuius afflatu recreatus vires deficientes subinde reciperet? Fit enim, nescio quo pacto, ut quo quisque eloquentior habetur, eo magis studiorum quaerat amoenitates. Ita cum plurimi sint qui Graecorum historias, fabulas, dialogosque accurate in Latinum sermonem converterint, opera elocutionis capacissima, et ad quae Latine exprimenda, non verba solum, sed verborum etiam sententiarumque figurae sponte suppetunt, ne unum quidem (quod sciam) reperias, de cuius eloquentiae aliqua fuerit hominum opinio, qui studium operamque suam ad interpretanda Graecorum Aristotelis enarratorum commentaria contulerit. Nam Theodorus Gaza, Ioannes Argyropylus, Hermolaus Barbarus, Hieronymus Donatus, a quibus poterat huiusmodi officium expectari, fuerunt illi quidem in physicis convertendis cum sua magna laude versati, sed ab Aristotelis enarrationibus prorsus abstinuerunt, non quod illa putarint parum nostris Peripateticis commodi esse allatura, quae proculdubio sunt paene necessaria (pudet enim discere, quanta caecitate, quod alias testatus sum, Latini exponendis Aristotelicis allucinentur) sed quoniam viri non minus cauti, quam eloquentes, aridam et ieiunam materiam, et non modo facundiae reluctantem, sed quae verbis Latinis exprimi parte sui non potest, velut scopulos in alto, Cyaneaque saxa vitanda sibi statuebant, dum laudem eloquentiae, quam inde longe etiam tenuiorem, quam ex ipso Aristotele convertendo reportare poterant, affectarent. Nec enim eos interpretum nomine dignos esse duco, qui graecos barbara quidem fidelitate sic interpretari student, ut nullum verbum perire aequo animo patiantur, ne ex iis quidem, quibus sermo graecus frequenter exornatur, et verba Graeca cum suis figuris eodem ordine, quo sunt ab illis constructa, transferentes, orationem reddunt, non dico barbaram, sed prorsus (ut ita loquar) inhumanam, ad quam explicandam Oedipo aliquo aut Apolline Pythio sit opus. Quod his accidit, dum sententias ignorantes, satisfacere se interpretis officio putant, si verba etiam minutissima quaeque velut inepta superstitione consectentur.

Itaque ut Iasone, cuius ductu invia maria navigarentur, sic Clemente pontifice opus fuit, cuius auspiciis, inaccessa nostris Graecorum Aristotelis enarratorum commentaria Latinis literis inciperent illustrari, ut hanc quoque partem studiorum Medicum clarissimae familiae mortales deberent, qui bonarum artium quicquid est in omni genere renascentium eidem referunt acceptum. [Sepulveda praises Clement's aid to the arts and then returns to his decision to have the *Commentaria in Aristotelis Metaphysica* translated. Alexander is of great authority among the Peripatetics, and Aristotle's philosophy (as the correspondence between Alexander the Great and Aristotle demonstrates) requires explanation. Sepulveda's task was difficult. He compared four manuscripts to obtain a good text, and he then had the problem of translating Greek philosophic terms into alien Latin. Only the memory of Clement frequently gave him courage to continue. 500 wds.] Quam memoriam subinde mihi suggerebat, studiorum quibus sese ab ineunte aetate tradiderat, fautor egregius, Io. Matthaeus Gibertus antistes Veronensis, vir acri ingenio, magno iudicio, et cana in iuvenili aetate tum prudentia, tum etiam gravitate. Hac enim recordatione viribus sumptis, pugnam tam saepe redintegrabam, donec superior mihi viderer evasisse, praeter loca nonnulla, quae librariorum incuria in omnibus quae mihi videre contigit exemplaribus, depravata esse, non tam ingenio meo fidens asseveraverim, quam assensu Nicolai Judeci confirmatus, viri doctrina singulari exactoque iudicio, et cui eruditorum consensus neminem, ut video, huius aetatis in omnis philosophiae et medicinae, quaecumque graecis literis continetur, nodis explicandis et Latine transferendis anteponit. Ego enim mihi impeditissimam quamque difficultatem non satis

ante videbam explicasse, quam iudicio eius satisfecissem, cum quo talia loca saepe, dum per ipsius occupationes liceret, conferebam. [The few passages still unclear are marked with asterisks. Sepulveda realizes that many will attack his work. He does not think it perfect but he believes that only those knowing both Greek and Latin as well as philosophy are in a position to criticize it. He particularly feels that the "grammarians" should not attack it for reasons of style. 250 wds.] Ex tribus enim infimus hic est enarratorum dicendi character, cuius decorum in simplici dictione versatur, et verbis suo in genere perusitatis, cui si Graeci Aristotelis enarratores ad hunc modum cum sua laude servierunt, nos quibus eorum scripta latinitate donantibus non licet ab ipsorum vestigiis discedere, quis prudens accuset, quod non turgidius inflemus, nec eos orationi fucos adhibeamus, quibus comi solent tragicae rhetorum declamationes? An parum praestabit, qui non minus eleganter illorum opera Latine expresserit, quam ipsi Graece conscripserunt? qua fiducia Theodorus Gaza homo Graecus se libros Aristotelis *De natura et generatione animalium* convertisse, in ipsorum praefatione profitetur. Quod ego an fuerim assecutus, iudicabunt alii, ipse certe ut assequerer quoad licuit elaboravi, non quod sermonis elegantiae alieno in loco primam curam habuerim (profiteor enim me in hoc opere non aliam elocutionem adhibuisse quam quae extemporanea facultate quantulamcunque usu comparavi, mihi suppetebat) sed quoniam Graeci quoque ipsi Aristotelica enarrantes, domestica et familiari dictione usi sunt, quae per mediocrem exercitationem haud magno negotio contingat. Ad illud ego me omne ope comparavi, primum ut, quod te mihi aliquando praecipere memini, sermo esset Latinus quidem sed non fucatus nec ambitiosus; deinde ut orationem quantum res patitur illustrarem; tum in primis ut auctoris non modo incorruptas sententias, sed verba etiam quatenus sermonis Latini ratio permittat, transferam. Hoc enim quod alias vitium videri potest, summam esse virtutem in hoc genere interpretantis philosophi putant, qui in rebus obscurissimis non tam fidem interpretis, qui suus esse velit, sequi, quam integram facultatem sibi dari cupiunt, de auctoris mente iudicandi, quam tunc magis sibi contigere putant, si cum sententiis verba quoque sed Latina fidelitate transferantur, quae per me ut praestarentur, pro virili conatus sum. Ut autem lector quem sequatur habeat sitque incommodo eo liberatus, quod mihi passim negotium facessebat, Aristotelis verba, quae Graece cum verbis Alexandri permixta et admodum confusa sunt, Io. Argyropyli traductionem sequutus, lineis quibusdam distinxi, qua diligentia effectum esse spero, ut Latinus Alexander quam Graecus nihilominus perspicuitatis habeat. Quod vero quibusdam in locis ab Argyropyli interpretatione abhorreamus, nequis id putet negligentia quapiam fuisse commissum, partim idcirco fecimus, quoniam ea quandoque nobis haud admondum probatur, partim quoniam licet sententias ille recte convertisset, Alexandri tamen enarratio alia verba, aliam verborum seriem postulabat, cui enarrationi auctoris dictio nobis fuit accommodanda. Vale.

Sepulveda introduces a second preface at the end of Book V.

Ad Clementem VII Pont. Max. Io. Genesii Sepulvedae Praefatio in Alex. Aphr. Enarrationem posteriorum librorum Arist. de prima philosophia.

Hoc quoque in loco, Clemens Septime, Pont. Max., pauca me praefari sine, et more nobilissimorum poetarum in medio tanquam operis cursu, opem divinam, hoc est nomen tuum implorare. [Sepulveda praises Clement. He now is convinced of the falsity of the opinion which refuses to admit Alexander as the author of Books VI and following of the *Commentaria*. 200 wds.] Quae opinio incertis, ut necesse est, ac dubiis initiis exorta, tam late diffusa erat, ut nemo iam esset in Italia qui modo Graecis scriptoribus dignoscendis paulo fuisset curiosior, cui error hic non esset in primis persuasus. Quod tunc mihi magis licuit intelligere, cum primum mihi a te hoc convertendi negotium iniunctum esse increbruisset. Plerique enim dum tibi apud me gratias agerent, quod tanti philosophi lumine Latinos homines diutius carere non patereris, meque simul ad fructuosissimum opus adhortarentur, sed illud dolendum esse aiebant, quod ceteris fere Alexandri enarrationibus amissis, ne hanc quidem primae philosophiae totam retineremus. In hanc sententiam ex Academia Bononiensi amicorum literas suscepi, in hanc ex Gymnasio Patavino. Hoc mihi Romae doctissimus quisque asseveravit. Quorum consensu quamquam erat difficile non permoveri, profiteor tamen numquam me sine magna cunctatione fidem adhibuisse, propterea quod omnes sine auctore loquebantur, et me-

mineram multos hac memoria repente Aristarchos extitisse, qui rerum novarum cupidi, facilius de totis philosophorum libris vixdum altera pagina perlecta, quam vetus ille de singulis Homeri versiculis iudicarent. [Sepulveda therefore investigated the problem thoroughly. He declares that there are four main grounds of a decision on authorship: (1) inscriptionum antiquitas; (2) dicendi character; (3) opinionum constantia; (4) ratio testimoniorum. All four grounds support the authorship of Alexander, and there should no longer be any doubt about ascribing the work to him. 750 wds.]

VI,*a*,1. Ioannes Grammaticus, *In libros de generatione et interitu*. Alexander Aphrodisiensis, *In Meteorologica*. Idem, *De mixtione*. Venetiis, apud Aldum, 1527.

Franciscus Asulanus Iacobo Sadoleto Episcopo Carpentoractensi, S.P.D.

Cupienti mihi atque exoptanti ut philosophia, qua nihil praestantius, nihil homini melius natura dedisset, in pristinam dignitatem revocaretur, una ratio occurrebat, si librorum copia veterum conquireretur, studiosorumque causa publicaretur. Quare, quod ad nos attinet, interpretationes nobilissimorum Peripateticorum in libros de rerum naturalium principiis, de coelo, de anima, de sensu et sensibili, de vita et morte, aliosque Aristotelis libros hoc anno ad omnium utilitatem emisimus. Cum autem proxime et Ioannis Philoponi in duos de generatione et interitu libros, et Alexandri in Meteorologica explanationem, eiusdemque de mixtione opus ederemus, te in primis dignum putavimus, cuius nomine hi de philosophia libri in lucem prodirent. Iam enim eam eloquentiae ac sapientiae laudem es consecutus, quod non obscuro, sed uno doctissimi cuiusque sermone ac iudicio celebratur, ut te ducem ad philosophiam illustrandam praebente, nihil praeterea requirendum videatur. Nam cum et Hortensium excitaris, et multa alia politissime scripseris, te autem in istum secessum officii et studiorum causa contuleris, quid est in omni genere laudis tam excellens, quod non ab ingenio atque eruditione tua expectari non possit? Nos vero expectamus speramusque, aut confidimus potius, cum philosophiam meliorem, tum christianam religionem ad retinendos atque inflammandos animos aptiorem, ut nitidius tua opera illustratam, Latinos brevi habituros. Neque enim veremur ne maneas in sententia, qua ex te Urbe profectum, cum ex aliis, tum vero ex Lazaro Bonamico cognovimus, quo nemo plura praeclara quidem illa ac pene divina, sed tamen (ut solet) vera de te numquam desinit magna auctoritate apud optimum quemque et sentire et praedicare. Quod ut facias, hos ad te monitores misimus, qui non tam te hortarentur quam flagitarent, et hoc iam debitum Latino nomini munus postularent, quod et dignitatem in qua es, et saeculum nostrum non mediocriter ornabit. Vale literarum decus.

VI,*b*,3. *Commentaria in Aristotelis Meteorologica*. Partial translation by Ludovicus Nogarola, *circa* 1536, here cited from ms. B C 10 × 11, University Library, Glasgow, Scotland.

Amplissimo et Illustrissimo Bernardo Clesio SS Sedis Romanae Cardinali Episcopo Principique Tridentino, Lud. Nogarola Comes Veronensis.[3]

Multae quidem Dei optimi maximi munere concessae nobis sunt artes et scientiae, Antistes Ampliss., sed tamen nulla iucundior, nulla fructiosior dari potuit ea philosophiae parte quae de natura et rebus occultis pertractat. Ipsa enim tum animos nostros magis perficit ac exornat, tum ceteras artes eamque potissimum quae curat morbos, gubernat et regit. Incredibilique quoque voluptate nos afficit dum a primis rerum initiis exorsa paulatim quasi per gradus in coelum nos usque perducit, ubi genitorem effectoremque mundi, offusa tamen quadam caligine, nobis ostendit.

Sidera tam inerrantia quam vaga describit, quorum etiam metitur motus constantes et ratos. Mox inde in terram revertitur, et quae infra lunam sunt corpora, sigillatim recenset, ut quaedam eorum solitaria atque simplicia, nonnulla concreta admixtaque sint, ut item alia animata, alia habeantur inanimata. Postremo omnium animantium ortus, partes, et natura prosequitur, quorum principem constituit hominem, quippe qui in integritate sensuum et mentis praestantia ceteris antecellat, eaque sit intelligentia praeditus, qua per omnia permeet, qua Deum beatissimasque mentes (quamvis obscure) concipiat eisdemque sese (quae sola

[3] The salutation, and part of the body of the preface, has been corrected in this manuscript so that it be addressed to Mary of Hungary, 1505–1558, who was regent for Charles V in the Netherlands 1531–1556.

certe in hac vita nostra beatitudo est) conciliet atque coniungat.

Harum rerum tam admirabilium cognitio contemplatioque Dei sunt munus ac inventum. Tamen etsi Graecorum monumentis eleganter prodita, decorata sit (?), eo tamen genere laudis nostris temporibus caret, quod nondum satis videatur Latinis literis illustrata. Cuius quidem incommodi ea imprimis causa putanda est, quod priscorum illorum hominum libri, qui Latino sermone res a natura involutas explicaverunt, magna ex parte longinquitate temporis interierint, quo factum est ut tam multa Varronis, M. Tulli, et Bruti aliorumque complurium desiderentur volumina, quorum si nunc copias haberemus, profecto nobiscum praeclarius ageretur, ut in tractandis naturae rebus nec in transferendis Graecorum philosophorum ingeniis (?) tantopere laboraremus.

Adde etiam quod inclinato iam Romano imperio atque Italia a barbaris gentibus occupata quoddam extitit doctum quidem sed tamen inelegans hominum genus, qui rem spectari oportere non verba existimabant, atque idcirco tantam sibi licentiam permitti voluerunt, ut qui recte sentirent, neglecto omni orationis ornatu temere loquerentur et scriberent. Quorum cum summa esset auctoritas, eam disciplinae formae instituerunt, ut qui se vellent sectari, non diu apud grammaticos versarentur, sed statim primis eius artis rudimentis imbuti ad Aristotelem eundemque male conversum se transferrent, Ciceronem et reliquos probatos Latinae linguae auctores, nec legerent nec attingerent. Ex quo illud saepenumero eveniebat, ut qui politius essent eruditi, verbis illorum duris et odiosis deterriti, a percipiendo tam utili tamque iucunda scientia penitus abhorrerent. Haec tamen philosophandi ratio horrida sane ac inculta ad nostram usque manavit aetatem ac pertinaces semper habuit patronos, per quos parum abfuit quin Latinae philosophiae lumen extingueretur.

Quae quidem calamitas sine dubio contigisset nisi huic immani ac intolerandae barbarie Theodorus Gaza primus restitisset, vir sane in utraque lingua peritissimus, qui versis nonnullis summa cum laude Aristotelis ac Theophrasti commentariis magnum philosophiae patrocinium attulit. Subsecuti sunt et alii, qui plures libros a Graecis conscriptos in eadem disciplina Latinos fecere.

Sed cum in philosophiam admodum deformatam incidissent, minime tam brevi humanae vitae spatio efficere potuerunt, quin immensum posteris laborem reliquerent, quam quidem rem cum his proximis ante annis animadverterem, cupiditate sum quadam incensus sequendi illorum vestigia. Quapropter Alexandri Aphrodisiensis commentaria in Meteorologicos Aristotelis libros converti, idque potissimum feci, ut nostris philosophis, qui Graecarum literarum rudes sint, pro virili mea prodessem, dum Alexandrum, sine quo nemo olim Peripateticum sibi nomen vendicabat, de ventis, terrae motibus, fulguribus, aliisque huiusmodi naturalibus affectionibus disputantem mea industria legere possent. [Nogarola dedicates the translation to Cardinal Clesius. He mentions that since the Cardinal studied at Verona, he is, as it were, a fellow-citizen of Nogarola. He particularly praises the Cardinal's magnificence, seen recently in his reception for Ferdinand, King of the Romans, his queen, and his retinue. 500 wds.]

VI,*b*,4. *Commentaria in Aristotelis Meteorologica.* Translation of Alexander Piccolomineus, here quoted from the first edition, Venetiis, apud H. Scotum, 1540.

Illustrissimo ac Reverendissimo Domino &c. Domino Francisco Bandineo Piccolomineo Archiepiscopo Senarum Optimo, Alexander Piccolomineus S.

Complurimi, Praesul amplissime, tum de natura, tum etiam de his maxime quae ex ipsiusmet hominis voluntate ortum habent, inter clarissimos viros Vincentium Magium, praeceptorem meum, philosophum sane praeclarissimum, ac aetatis nostrae celeberrimum, et Speronem Speronium, virum illustri philosophia praeditum atque uberrima ac consummata eloquentia insignitum, si quando una simul sunt (quod propter eorum arctissimam necessitudinem, non raro incidit) diligentissima perscrutatione sermones habiti sunt atque in dies habentur, quibus cum intersum nihil mihi amplius optandum censeo, quippe qui illos non solum unice amo, sed et eorum doctrinam non minus admiror, quam Hieronymi Mandoli Piccolominei, affinitate tibi coniuncti, in gravissimis quibusque rebus gerendis prudentiam, ac vim illam animi, quam solertiam vocant, admiratus fuerim semper. Cum igitur elapsis diebus una simul cenassent, in sermonem demum inciderunt, de eorum temporum felicitate, quibus adeo integra et syncera viguit philosophia, ut per aliquot saecula, non solum in ipsamet Graecia, verumetiam in aliis quamplurimis et Europae et Africae civi-

tatibus, viri sapientissimi passim conspicerentur. Et cum philosophiam recentiorum temporum quasi deperditam, ad multam iam noctem deplorassent, inquisiverunt tandem, curnam temporibus his, cum eiusdem met rationis homines sunt, non etiam et eadem sapientia illustres inveniantur. Cuius rei cum plurimas assignassent causas, veluti lationem corporum caelestium, a quibus haec inferiora gubernantur, quinetiam et periodum quo secundum augmentum et decrementum omnia terminantur, atque honorem insuper qui scientiis ea tempestate habebatur, et aliae rationes quam plures. Duas tandem mecum illas dehinc ego animo volvens, efficacissimas ac potissimas existimavi, quarum altera quidem, recentioris saeculi ambitio est, quoniam vitio temporum, liberalia studia, magis ut scire videremur, quam ut vere sciremus nunc usque insequuti fuimus, per argutias potius atque cavillamenta quam pro veritate ipsa disserentes, quippe qui inanem tantum gloriam maxime inhiantes affectavimus. Atqui econtra, antiqui ipsi prae omnibus aliis rebus, veritatem solam expetebant.

Altera vero causa est, ea qua laboramus idiomatum indigentia, in quibus scientiae ipsae reperiuntur. Veteres enim illi, cum nullo idiomate pro scientia rerum indigerent, praeterquam eomet, quod ex ipso nutricis gremio addidicerant, confestim ex ipsis cunabulis, ad philosophiae studium accedebant, adeo ut ante duodecimum pene annum, mathematicas disciplinas optime percallerent, post quas ad morales literas, ac deinceps ad naturales, et tandem ad divinas accedentes, sapientissimi foelicissimam vitam agerent. Nos autem versa vice cum ex nativo idiomate ad liberalium disciplinarum doctrinam nullus aditus praestari potest, non solum Latinae linguae acquirendae, quasi nobis externae, per multos ac ipsos etiam meliores damus annos, verum etiam et Graecis literis, cum magis extraneae nobis sint, longe plures annos concedimus, ita quod vigesimum quintum fere annum, ac plerunque trigesimum, etiam in alteri studio non vacemus, dum linguas addiscimus, attingentes, nihil tunc adhuc scimus. Quare neque per reliquum aetatis, satis in scientia rerum proficere possumus, quippe qui florentes ac ferventes iam annos, in quibus disciplinae ipsae optime radicarentur, quasi frustra conterentes, per reliquam aetatis partem, languescentem iam iam et in senium festinantem, vix superficietenus, ac primoribus (ut aiunt) labris scientiarum fontes degustamus. Haec itaque cum ita se habeant, atque ex his duabus maxime causis, philosophia ipsa nobis lateat in obscuro, non possum nisi satis laudare fortunam eius quae huic nostrae succedet aetatis, in qua cum hasce causas amoveri iam videam illa (ut spero) veterum sapientia reviviscet.

Video enim ambitiosam illam consuetudinem quam recentiores proximioribus saeculis ambitione dediti, introduxerunt, iamiam paulatim maxime aboleri, ac relictis et repudiatis cavillamentis et sophismatibus veritatem ipsam inquiri, cum in studiosorum manibus, non amplius recentiorum quaestiunculae eo quo solebat ardore conspiciantur, sed earum vice optimorum scriptorum opera incipiunt pertractari, qui diligentissime ac syncere philosophati fuerunt, veluti sunt Alexander ille Aphrodisiensis, Themistius, Ammonius, Philoponus, Simplicius, Eustratius, Olympiodorus, et alii si qui tales existunt. Quorum iam plurimi Latinitate donati sunt, ac donantur in dies, ut brevi admodum sperari posset, omnes in Latinum sermonem translatos fore. Quinetiam (si quid veri umquam praesagit animus) Aristotelem ipsum, ac eosmet quos enumeravi expositores, ad Tuscum idioma pertransire non multos post annos, sperandum esse arbitror. Quod si Deus ipse permiserit, non amplius dubitandum erit, quin sapientissimi viri veteribus illis simillimi, passim non habeantur. Cuius ego rei ardore ductus desiderabam et ipse in huiuscemodi translationibus, aliquid quandoque adiumenti afferre posse, quod ut facilius consequi valerem, aliquot post ultimas anni huius a studiis vacationes, in alicuius scriptoris translatione, exercitationis gratia destinavi dies, quippe qui satis intellegebam, quantum in unaquaque re valeat exercitatio. Cum itaque (ut in hac anni parte mei moris est) in Villulam quandam, amoenam quidem, et a conventu hominum semotam satis me contulissem, atque ibi post dulcissimi fratris discessum paene solus remansissem, Alexandri Aphrodisiensis in libros Meteorologicorum commentaria collatis simul quamplurimis exemplaribus ad Latinitatem transferre aggressus, non prius destiti quam perpetuo calamo, totam translationem non absolvissem. Quam, cum amicorum plurimi hortarentur ut imprimendam traderem, illorum suasionibus, et praesertim Ugolini Martelli iuvenis et morum bonitate et doctrinae singularitate insignis, quem ego plurimi facio, tandem acquievi. Quod eo libentius feci, quo in hoc saltem studiosis prodesse arbitror, quoniam ab innumeris paene mendis, quibus Graecus Alex-

ander infectus apparet, summa ipsum diligentia liberavi. [Alexander pays tribute to the kindness of Franciscus Bandineus Piccolomineus, which he has known since childhood. 75 wds.]

Patavii, Quinto Idus Septembris, MDXL.

VI,*b*,5. *Commentaria in Aristotelis Meteorologica.* Translation of Johannes Baptista Camotius, here quoted from the first edition, Venetiis, apud Franciscum Camotium, 1556.

Primoribus populi Senatuique Maceratensi, Io. Baptista Camot. S.

Studia et officia erga me vestra libenter mecum ipse cogito atque considero, Patres optimi Maceratenses, et si qua in re celebrare atque commemorare possum beneficia, quae a vobis accepi amplissima, cumulatioraque in dies accipio, nullum tempus praetermitto de re tali tantaque et agendi et cogitandi. [Camotius praises the zeal for education displayed by the people of Macerata. He continues with a long eulogy of the city, its surroundings and its history. 1,000 wds.] Sed quid ego ago? quonam me provehit oratio? neque enim civitatis vestrae celebrandae locum neque provinciam suscepi, quippe cui tantum in animo est, me, quam memor sim vestrorum erga me meritorum et officiorum ostendere.

Ego enim cum superioribus annis a Patavina Bononiensique iuventute literarum philosophiae studiosissima efflagitari et misere quasi vocibus omnium deposci viderem Alexandrum Aphrodisiensem in Meteora Aristotelis; et ora doctorum hominum (quod minime arroganter dictum velim) in me conversa animadverterem, quam in omnium rerum natura potissimum cognoscenda et in utriusque linguae doctrina plurimum versari intelligerent; et quem praetera scirent Olympiodorum in eadem Meteora cum Philoponi libro primo nuper Latinum fecisse, itidem et Psellum in Physica, existimavi suis tantis erga me studiis ac voluntati minime deesse velle, ut hanc quoque Meteorologicae philosophiae partem Latinis pro virile ope nostra illustratam literis et expolitam, posteaquam spem in nobis talem reponerent, sibi haberent. Itaque malui male versi fortasse de Graeco Alexandri infamiam subire, quam ipsorum meritis votisque non respondere. Ita Alexandrum Aphrodisiensem in Meteora Aristotelis de Graeco versum vobis, Patres Maceratenses, dicare et consecrare constituimus, ut, quoniam tam bene meriti de me essetis, meae quoque erga vos fidei et observantiae pignus aliquod monumentumque haberetis. Quod simul cum nomine ac fama civitatis vertrae sempiternum sit, optare possum: praestare nequeo. Valete.

Camotius adds a second brief preface in praise of his brother, Johannes Franciscus Camotius, the publisher of his translation.

Camotius Philosophiae Studiosis. S.

Johannem Franciscum Camotium fratrem meum salvere iubete boni omnes, quos amat Ζεῦς καὶ Παλλὰς Ἀθήνη. Is enim labores capere maximos incipit in libris monumentisque excudendis tam veteris quam nostrae tempestatis scriptorum, et quod vixit aetatis usque adhuc, in re libraria omne consumpsit, dum studet placere omnibus tam doctis quam indoctis. Ego sumerem operam frustra Graeca Latina faciendo, nisi suis ipse subiret humeris, et laborem meum levaret. Scitis enim propemodum omnes, quam vestris servire studeat commodis Camotiorum familia, ex qua prodire festinant tum Graeca scripta et monumenta, tum interpretes docti, qui in Aristotele interpretando otia sua consumpserunt, in Latinum conversi sermonem, ut liceat aliquando tum Graecis tum Latinis philosophari literis. Applaudite laboribus nostris, et praesertim fratrem meum aliquo in numero habeatis, vos etiam atque etiam rogo. Vale.

VII,*a*,1. *Alexandri Aphrodisiensis Commentaria in Aristotelis Topica*, Venetiis, apud Aldum, 1513.

Aldus Pius Manutius Alberto Pio Carporum Principi ac Caesareae Maiestatis Apud Pont. Max. Oratori, S.P.D.

Optima quaeque difficillima factu esse, cum aliis plurimis, tum praecipue in dura hac provincia nostra emittendorum librorum utriusque linguae in manus studiosorum sum saepe expertus. Alia enim ex aliis impedimenta et incommoda non cessant obstare iam multos annos, ne, ut cupimus, prodesse possimus bonarum literarum studiosis, ut nuper accidit. Differebam edere Alexandri Aphrodisiei in Topica Aristotelis commentarios, superiore anno excusos cura nostra, expectans, quos in ea ipsa Topica Graece scripserat commentarios Franciscus Victorius Bergomas philosophus et medicus quamdoctissimus in quibus et stylo et doctrina certare videbatur cum eo ipso Alexandro et caeteris Graecis, qui vel Platonem vel Aristotelem

doctissime interpretati sunt, ut una cum Alexandri commentariis publicarentur, quod opus ad circiter quinquaginta quaterniones excreverat. Sed fortuna tot labores, et tam doctas lucubrationes invidit nobis. Nam paucis ante diebus, quam haec ad te scriberem, domus, quam ille habitabat, tam repentino celerique incendio tota absumpta est, ut et ii, quos dixi commentarii, et tota eius bibliotheca optimorum plena librorum utriusque linguae miserabiliter arserint. In quibus erant et in totum Platonem tot annotationes, ut iam pro iustis haberi commentariis possent. Erant et in Galenum, et caeteros medicos aliae, ex quibus non unum sed multa confici volumina potuissent. Sed quoniam superanda omnis fortuna ferendo est, tum quia ἐλπίδες ἐν ζωοῖσιν non solum aequo fortique animo fert, quam fecit, iacturam, sed brevi in illa ipsa Topica commentarios vel cum usura, hoc est non solum Graece, sed et Latine se daturum confidit, et pollicetur, tum alia multa suo tempore dignissima cognitu. Et si, nondum trigenta annos natus, vel tantundem vixerit, non dubito, quin sit et quae pollicetur, daturus omnia, et superaturus nostram caeterorumque amicorum expectationem, quemadmodum et Patavii fecit, ubi adolescens summa cum laude, et frequentia auditorum publice professus est philosophiam. IESUS igitur Deus optimus maximus, cuius et est et semper fuit reverentissimus, dignos illius inceptus fortunet, ut spero futurum, ob miram ipsius iustitiam et probitatem. [Aldus discusses how God tests His servants by tribulations, as in Job, or Ulysses and Aeneas. Even Christ undertook such tribulations as an example for us. Victorious has been true to his name in rising above his troubles. 500 wds.] ...quia non solum optimus homo est, sed et Christi cultor optimus. Qui si fuisset temporibus Socratis vel unus facile potuisset eorum opponi calumniae, qui dicebant philosophos negare esse Deos, Socratemque ipsum, qui Apollinis oraculo, quod tunc verissimum habebatur, sapientissimus est iudicatus, ἄθεον iuventutisque corruptorem esse praedicabant.

Sunt tamen et nunc nonnulli, qui hoc idem existiment, quod videant quosdam, qui profiteantur se esse philosophos et non sunt, pessime vitam agere, et scatere vitiis, ob eamque causam dicere non esse deum, vel si sit, nullam illi rerum humanarum esse curam, tum animos hominum cum corporibus interire. Sed tota errant via, mea quidem sententia; sunt primum viri quam optimi veri philosophi, expertesque vitiorum omnium, ex quibus te unum esse, possem esse ipse optimus testis qui te a puero institui et erudivi, quamquam et me, et caeteris deinceps longe melior et doctior evasisti praeceptoribus. Πολλοὶ γὰρ μαθηταὶ κρείττονες διδασκάλων. Sunt inquam primum optimi viri veri philosophi, deinde non modo ipsi deum esse credunt, ab eoque uno et mundum et quae in eo sunt omnia perpetuo regi et gubernari, sed id ipsum et docent alios sedulo et memoriae produnt, id quod ex Apologia Socratis facile est cognoscere, in qua divinus ille philosophus et gratissimus omnium discipulus Plato adversus illam ipsam improborum et malevolorum calumniam Socratem inducit disputantem. Sed γλαῦκας εἰς Ἀθήνας qui haec ad te.

De Victorio autem nostro an vera scripserim, et ex doctis eius lucubrationibus brevi, ut spero, cognosces, et coram aliquando. Interea hosce Alexandri commentarios sub tuo nomine a nobis editos in manus hominum, siquid occupatissimo tibi maximae molestiarum et turbulentissimae tempestates nostrorum temporum tribuent otii, cum ipsorum doctrina et excellentia studiose leges, tum etiam quia Musurus noster eos cum antiquis conferens exemplaribus accuratissime recognovit. Dabuntur deinceps Deo volente caetera omnia in Aristotelem, ut olim memini polliceri, cum primum absoluti fuerint Strabo, Athenaeus, Pausanias, Xenophon, quos multorum rogatu nunc imprimendos curamus. Dabuntur et alia suo tempore. Nam etsi

> Vicinae ruptis inter se legibus urbes
> Arma ferunt, saevit toto Mars impius orbe

Tamen quieturi nunquam sumus, nisi pollicita praestiterimus, saxumque illud gravissimum, quod tot annos assidue volvimus, in montis apicem perduxerimus. Vale decus ingens Principum, et gloria huius aetatis philosophorum.

Ven. XV Feb. MDXIV.

VII,*b*,3. *Commentaria in Aristotelis Topica.* Translation of Guilelmus Dorotheus, first published Venetiis, apud H. Scotum, 1541, here quoted from the edition, Parisiis, apud J. Roygni, 1542.

Clarissimo Marco Antonio Venereo Doctori, ac Senatori gravissimo, Guilelmus Dorotheus Venetus felicitatem.

Cum e Neapoli decedens Octaviani Scoti a typis et studiorum et partium necessitudine coniunctissimi mei suasu Venetias venissem, nihil mihi potius et studiosis philosophiae utilius

faciendum venit in mentem, quam antiquos Aristotelis interpretes Graecos, Latinis literis mandare, ut officina bonarum in philosophia literarum, quae tot ante annos conticuerunt, vel omnibus maxime nostris hominibus pateret. Certe enim scio ampla interpretum Aristotelis et subtilia ingenia viguisse, sed Graecis limatiora probatioraque id nemini confirmarim, quorum commentarios partim in lucem e tenebris optimi impressores vindicarunt, partim reconditos esse novimus et intelleximus. [Dorotheus notes the many enemies of letters in his time. 100 wds.] At tu, Senator optimus et literarum professor, fautor, et praedicator contra ratus es, qui mihi ut saepe ita amicissime hortatus es ad munus evertendi Graecos interpretes, quo multorum usui hac in re unus ipse etiam ex Venetis, qui plures sunt Graecis et Latinis Hebreisque literis admodum periti, plane viderer, id item liberaliter literarum cupidis profunderem, quod gratis a Deo accepi. [Dorotheus praises Venereus and his family. He mentions Venereus' work as ambassador to the Pope and his providing for the Venetian army when Francis I was besieging Pavia. 450 wds.] ...nulla tamen earum causa est, qua potissimum impulsus hoc commentarium Alexandri Aphrodisei in librum Aristotelis (ut vides) de sede locisque argumentorum a me nuper Latinis literis illustratum tibi inscriberem, sed tua imprimis doctrina et philosophiae cognitio, quippe qui doctissimus Peripateticus et praecipuus Averroista dudum fuisti, atque nunc, quem praesertim interpretem tum secutus es, quod omnium pace primas Averroes habuit, dum limatiores et Graecae latuerunt. Sed ubi meliores et politiores in lucem prodiere, tu Senator optimus et philosophus, iuvandis gymnasiis et studiosis addictus me saepissime admonuisti, ut vigilias huiusmodi vertendi Graecos mihi sumerem, quae saluti meae prae caeteris, deinde omnibus prodessent, quam optimam pro tua in me humanitate et benevolentia exhortationem, ipse Octaviano Scoto a typis aperuissem, ambo in tuam venimus sententiam. Et cum Alexander maximus exstiterit Aristotelis interpres (ut cuncti facile dabunt) tibi Senatori et philosopho librum Topicorum destinavimus, ipse maxime ut ostenderem quantum debeam patritio certe patriae meae prudentissimo, ille vero quanti faciat, cum famam optimi viri, tum etiam docti. Utrosque igitur variis atque eisdem de causis tuae excellentiae et nobilitati maxime devinctos, et librum inscriptum ut tua mancipia [municipia] velimus, accipias. Bene vale.

VII,*b*,5. *Commentaria in Aristotelis Topica*, Book VII. Translation by Marcus Antonius Muretus, first published Venetiis, Gryphius, 1554, here cited from the edition of 1602, Ingolstadii, A. Sartorius.

M. Antonius Muretus L. Memmio Fremioto patricio Divionensi. S.

Quibus ex causis quaeque res effecta est, Luci Memmi, earum interitu ac commutatione ipsam quoque labefactari ac concidere necesse est. [Hence vulgar friendships are easily dissolved but not the attachment of Muretus to Fremiotus. 125 wds.] Cuius rei non tibi, cui hoc certissimum est, sed ceteris omnibus indicium volo esse, quod cum hunc Alexandri Aphrodisiensis (si verus est index) librum animi causa e Graeco interpretatus, etiam in publicum edere statuissem, neminem habui, cui eum potius dicatum vellem, quam tibi. Vale.

Venetiis, Cal. Juliis, MD LIV.

VII,*b*,6. *Commentaria in Aristotelis Topica*, Book III. Translation of Petrus Gherardius, here cited from the first edition, Florentiae, apud filios Laurentii Torrentini et Carolum Pectinarium socium, 1569.

Francisco Medici Florentinorum ac Senensium Principi Petrus Gherardius S. D.

In arte disserendi quae dialectica dicitur, summam esse utilitatem, et verbis et re docuit Aristoteles.... [Gherardius praises dialectic, and notes its importance to such thinkers as Plato, Aristotle, Demosthenes, and Cicero. He particularly emphasizes the value of Book III of the *Topica* together with the *Commentary* on it of Alexander of Aphrodisias. 600 wds.] Huius ego interpretis et singularem doctrinam et exquisitam elegantiam cum essem aliquando admiratus, superioreque aestate, a gravissimis philosophiae et medicinae studiis exclusus, Aristotelis Topica regustarem ac recognoscerem, cepi ad hunc tertium librum relapsus, quae Graeco ille sermone tractaverat, ea Latinis literis animi causa mandare et quae dudum ipse ex bonis scriptoribus ex aliisque Aristotelis libris in hunc adnotaveram, colligere et suis quaeque locis collocare. Id autem eo consilio feci, ut adolescentes, si quando in eorum manus haec scholia pervenirent, quomodo propositis locis utendum sit, intelligerent, et ad imitationem accenderentur. Neque vero animum ad Alexandri commentarios interpretandos adieci, quod existimarem posse me eos e Graecis bonis

Latinos facere non malos, aut quod sperarem illos mea opera conversos et aliquando in lucem prolatos, nonnihil gloriae mihi apud homines comparaturos. Quid enim ingenio, quid scientia valeam, mihi ipse sum conscius, praeterquam quod non ignoro hominem adolescentem, qui parum ob aetatis infirmitatem in gravissimorum auctorum lectione versatus sit, nihil quicquam egregium, nihil magnopere laudandum posse expromere. Sed cum viderem, politissimum scriptorem ob ineptiae cuiusdam translationis culpam in sordibus atque illuvie iacere; quae quidem res et illorum intelligentiae, qui Graecae linguae ignari libros Latine scriptos pervolutare coguntur, miruminmodum officiebat; utrorumque vicem dolens, non ab re fore putavi, si, quae Graece ab illo tradita erant, ea de integro in Latinum sermonem converterem, ac si fieri posset, aliquo orationis nitore explicarem. Rem itaque suscepi, sed eam postea tantum esse cognovi, ut non solum perficiundi spe destituerer. sed etiam experiundi voluntatis me poeniteret.

Ea enim est Latinorum verborum inopia, praesertim quibus Peripateticam philosophiam explicemus, ut qui antea et Aristotelis et Alexandri sententias non horridioribus vocibus exprimere instituissem, idem postea, re tentata, in malorum interpretum consuetudinem delaberer. Accedebat eodem quod, cum ab illa in singulis fere verbis reddendis religione discedere, ne res obscurior fieret, neve Latinae orationis cultu destituta sordesceret, nimiam autem interpretandi licentiam ac libertatem cavere vellem, ut ne aliud genus loquendi quam quod commentariis conveniat effingeram, et interdum etiam ab ipsa sententia longe aberrarem, inter maximas difficultates constituebar. Haec cum ab instituto me deterrerent, tamen veritus reprehensionem eorum, qui me hoc opus aggressum esse intellexerant, malui illud, quoquomodo possem, absolvere et desiderari ab aliis scientiam meam, quam, si id non fecissem, industriam, nam si non omnis laudis perfectio, at conatus tamen atque adumbratio apparebit. In eo autem certe elaboravi, ut et Graecorum auctorum sententias fideliter redderem, et genus orationis planum atque expeditum adhiberem, quae si omni ex parte assecutus non fuero, ea fortasse a nonnullis aetati meae condonabuntur. Hos autem primos ingenii mei foetus, utinam tam felices quam laboriosos, tibi optime Princeps dicavi, ut cum ii per se essent obscuri, tui nominis splendore illustrarentur.

Quamquam cum diligentius mecum considero, non video cui magis debeat haec tenuis lucubratio nostra consecrari, quam tibi. Ea enim sunt in me tua, tuique omnibus laudandis rebus praecellentissimi patris in omnes meos beneficia, ut quicquid a me praestari potest, id tibi tuo iure vendices. Quam enim non gravate cum praestantissimorum virorum, Laelii Taurellii et Antonii Meliorii commendatione fortasse de me nonulla commotus esses, me in illorum adolescentium numerum aggregasti, quorum studia Pisis antiquissimo literarum domicilio tua summa benignitate foventur ac sustentantur. Quam liberaliter pater tuus, quo est erga bonos viros amore incredibili, Aloysium Gherardium et alios propinquos meos, qui vestrae honestissimae familiae inservierunt, fideliterque operam navarunt suam, tractavit, et amplissimis praemiis affecit.

Hoc igitur parvum opusculum, quod eorum, quae ego hoc tempore efficere et navare possum, maximum est, et eo etiam libenter a me lucubratum, quia desiderio flagrarem, non dico referendae tibi gratiae (qui enim hoc assequi licet, praesertim cum tu nullum aliud liberalitatis tuae praemium, nisi communem bonorum benevolentiam, expectes?) sed pietatis testificandae erga te meae, ita accipias rogo, ut quid virtuti, quid amplitudini tuae debeatur, non attendas, sed quid a iuvene, praesertim aliarum quoque artium studiis dedito, praestari possit, diligenter cogites. Erit autem humanitatis tuae, qua aliena etiam complecti et tueri soles, hoc qualecumque est, quod domi tuae natum, et ope antiquissimi codicis, qui in nobili maiorum tuorum bibliotheca, tanquam Minerva Phidiae, diligenter servatur, magna ex parte perfectum, ad te defero, ita ab iniuriis defendere, ut ad alia praestantiora, quae tuo munitus praesidio instituam, fiam alacrior. Vale.

Florentiae IIII id. Octobris M D LXIX.

Letter II.

Flaminius Nobilius lectoribis. S.D.

Quod Themistoclem dicere solitum memoriae proditum est, Milciadis sese trophaeis e somno excitari, id Petro Gherardio optimo atque eruditissimo iuveni plane accidit. Versabantur illi assidue ob os atque oculos praeclari cives sui, Remigius Melioratus, qui non multos ab hinc annos abiit, philosophus insignis, in dialecticis vero aetatis suae facile princeps; Christophorus Rufus et Bernardinus Petrellius, qui bono publico vivunt, quorumque opera in Aristotelis sententiis

explicandis ita probatur, ut eorum alterius nomen apud doctos homines magno in honore sit, Petrellius vero Patavii, id est in nobilissimo gymnasio logicam facultatem non mediocri cum laude profiteatur. Quamobrem istorum gloria incensus, ut patria quemque exempla magis quodammodo movent, in iisdem studiis, studium sibi suum locandum duxit.... [Flaminius praises Gherardius' progress. 75 wds.] ...cum aliquando inter nos de Topicis Aristotelis sermo ortus esset, facultatisque illius utilitatem valde commendaremus, nec vero quin Alexandri commentariis multum illi facultati accessionis factum esset, dubitaremus, sed doleremus vicem illorum, quos aut Graeci codicis frequentissimis mendis perturbari, aut Latino non tam converso, quam everso, utentes in desperationem prope adigi necesse esset, occasionem sibi oblatam putavit, qua et optimos illos cives suos imitandi et de hominibus bene merendi voluntatem testaretur suam.

Itaque interpretis longe optimi scripta in quatuor primos Topicorum libros, quae vere Alexandri sunt (nam reliqua ab eius eruditione et subtilitate longe absunt) et corrigenda tum veterum codicum inspectione, praecipue vero Medicaei, qui integritate ceteris praestans in magnificentissima illius familiae bibliotheca fideliter custoditur, tum similium locorum collatione, et de integro in Latinum sermonem convertenda suscepit eamque in convertendo adhibuit moderationem, ut nec orationis impurae sordibus sententiae ipsae vilescerent, nec nimia castitate obscurarentur. Verba serviunt rebus, sed ita serviunt, ut suam quasi dignitatem splendoremque retineant. Nec vero nobis dumtaxat Alexandrum reddidit, sed propemodum geminavit, dum copiosissimis scholiis Alexandri sensa patefacit locosque ab eo tractatos rursus tractat novisque tum a Graecis tum a Latinis scriptoribus acceptis exemplis illustrat. Quo in munere obeundo multa se a Petro Victorio summo et singulari viro sumpsisse non negat, a quo bonos omnes libentissime videt sumere. Ceterum cum tertius liber, sive casu quodam sive rerum, quae in eo tractantur, pulchritudine, animum ipsius magis ad se trahente, minus ei quam ceteri libri rudis minusque impolitus videretur, statuit hunc solum in praesenti edere, quo studiosorum iudicium eliceret, ac si placere intelligat, alacriter in reliquos expoliendos incumbat; sin minus, hac non maxima iactura doctus inani labore supersedeat. Ego vero, humanissimi lectores, pro mea in vobis fortasse non ignota charitate, vehementer hortor, ut hunc librum accurate legatis. Spondeo enim vobis, in meque recipio fore, ut temporis in eo legendo positi numquam vos poeniteat. Valete.

VII,*b*,7. *Commentaria in Aristotelis Topica.* Translation of Johannes Baptista Rasarius, here cited from the single edition: Venetiis, apud haeredes Vincentii Valgrisii, 1573.

Philippo II, Hispaniarum ... regi potentissimo, Io. Baptista Rasarius, Novariensis, Doctor, S.P.D.

Maxima semper fuit opinio, Potentissime Rex, iam usque ab eo die, quo regale sceptrum suscepisti ducta atque in animis hominum insita, fore, ut te regnante omnia quae vel ante vel corrupta, vel inchoata, vel nondum ad humanum usum producta essent, in pristinum statum restituerentur, ad suum finem redigerentur, et inventa ad hominum commoda adhiberentur.... [Rasarius praises the work of Philip II as continuing that of Ferdinand I and Charles V; Philip has shown particular concern for letters. 500 wds.] Haec sunt, rex potentissime, quae in te mortales admirantur, et de quibus cum singulari quadam animi voluptate crebris agit sermonibus vir summa virtute et praeclaris ornatus laudibus, Guzmanus Sylva, orator tuus apud Rempublicam Venetam, homo et in gerendis negotiis prudentissimus et in rerum cognitione praestantissimus, et de ecclesia Dei optime meritus. Cuius ego monitu atque auctoritate excitatus, et fretus ea humanitate, quam hic vir de te praedicat, ausus sum tibi tot regnorum administratione tantoque mole rerum occupato, nunc literis obstrepere, dum meam in tuum immortale nomen pietatem aliqua ex parte patefacere, et rei literariae, quoad eius fieri a me posset, adiuvandae cupiditatem declarare cupio.

Cum enim omnia quae labi videbantur, tuis auspiciis restitui perspicerem, iamque in Galeni libris emendandis et Latinitate donandis essem diu multumque versatus, videremque Alexandri Aphrodisiensis, Peripatetici nobilissimi, explicationem in octo Aristotelis Topicorum libros ita depravatam, ita laceratam, itaque mancam et quasi decurtatam, ut innumerabilibus in locis nullus elici sensus posset, existimavi non ingratam fore studiosis hominibus operam meam, si libros omnes calamo exaratos, quorum mihi copia suppeteret, inter se conferrem, ac quantum mea facultas ferret, depravata corrigerem,

lacerata resarcirem, manca supplerem, ac decurtata restituerem, quod quidem ego summo studio feci, summaque diligentia. Quantum autem profecerim, facile cognoscent, qui meum librum cum eo qui iam pridem Graece editus est, comparabunt; invenient enim plurima addita, plurima commutata, plurima denique restituta, ut iam Alexandri explanatio et legi et intelligi posse videatur.

Cum autem multi etiam a me efflagitarent huius libri interpretationem, quod mirificam utilitatem esset iis allatura, qui Graecas literas nesciunt, et tamen in disserendi ratione utiliter versari cupiunt, morem eis gerendum censui. Itaque librum ipsum in Latinum sermonem converti, ut quatenus disserendi facultas fert, eius artis scriptores Latine loqui assuescerent. Quod etiam eo praecipue consilio a me factum est, ut sicut cetera omnia in tuis felicissimis regnis quasi exuta vetustate revirescunt, ita hic liber, qui adhuc fere in squalore et sordibus iacuit, te rege aliquid lucis et ornamenti consequatur, quod ut omnibus perspicuum esset, curavi, ut in tuo immortali nomine appareret, ut quamdiu ipse liber legitur, tamdiu hoc admirabilium virtutum tuarum testimonium et meae summae in te pietatis extaret monimentum, Vale.

Venetiis, K. Augusti, M D LXXIII.

VIII,*b*,2. *De fato.* Translation of Hieronymus Bagolinus, here cited from the single edition, Veronae, ab Andrea B. C., impendio interpretis, 1516. The preface has been reprinted by R. Lemay, ed. *Petri Pomponatii Mantuani Libri Quinque De Fato, De Libero Arbitrio, et De Praedestinatione* (Lugano, 1957) p. 458–461.

Hieronymi Bagolini Veronensis in Interpretationem Alexandri Aphrodisei De fato ad Illustrem Ioannem Baptistam Spinellum Comitem Cariati Veronae Gubernatorem Caesareum Praefatio.

Cum incidisset nuper in manus meas, Illustris Comes, Alexandri Aphrodisei libellus De fato et libero arbitrio ad principes Severum et Antoninum Graeco sermone conscriptus, eum mox libenter avideque amplexus, legi atque perlegi saepius. Nam et auctoris nomine, quippe qui ex Peripateticis esset eminentissimus, et indice rei propositae, cuius veritatem supra modum omnes nosse desiderant, plurimum oblectabar. Inveni profecto (quod sperabam) tractatum argutissimis quaestionibus, acutissimis sensibus, verbis gravissimis iisdemque ornatissimis refertissimum. Sed id me in eo ante omnia incredibili affecit laetitia, quod ambiguitates plures perquam difficiles atque insolubiles nodos explorat, enucleat, discutit quodque veritatem ipsam fidei et religioni Christianae consentaneam aperit validissimisque et evidentissimisque argumentis confirmat, tuetur, et ut prosequamur hortatur. Contra Stoicorum opinionem ceu falsam et veritati adversam insectatur, reiicit et inexpugnabili ratione propulsat.

Hunc itaque cum perlegissem perlectumque literatis omnibus utilissimum fore iudicassem, non sine magno labore Latinum feci, cum omnes quotquot viderim codices mendosissimi essent. Et ne continuo sermonis decursu fastidium legentibus ingereret, in capita distinxi suisque indicibus singula pernotavi, ut primo occursu cuncta ante oculos constituta quibuscumque etiam conniventibus obvia et aperta fierent. [Bagolinus extols the virtues of Spinellus, and he notes that Augustinus Suessanus and Aldus Manutius have also dedicated books to him. 300 wds.]

Sed quid te longiore epistola detineo? Finem dicendi fecissem nisi me quorundam fati nominum expositio ad se vocasset quae inter Chrysippi rationes ab Alexandro adducta Graeca permisimus, cum non nisi longo verborum ambitu Latine dici aut apte exprimi possent. Legimus ab antiquis et philosophis et poetis qui in Graecia claruerunt fatum modo Imarmenen vocari, modo Pepromenen, nunc Aesan, aliquando Nemesin, quandoque Athraustian, nonnumquam etiam Moeran, plerumque et aliquo Parcarum nomine ut Lachesin aut Atropon. Imarmenen aliqui ut Porphyrius dictam putant, quod sorte quadam fata evenire dicantur. Alii quia sit quasi series quaedam causarum ad rerum productionem agentium, Pepromenen vero quoniam omnes ad finem suum fata perducant nec ullum sit infinitum. Aesan porro, quasi semper existentem quod fatum ipsum sit sempiternum et causae fati semper fuerint, ut libro De mundo Aristoteles sensit. Nemesin autem a distributione quam cuivis fata secundum merita exhibere dicuntur. Athraustiam quia fatum sui natura inevitabile sit frangique non possit. Moeran quod sua unumquemque fata comitentur. Idem et Lachesis significare videtur quod sua singulis sors contingat et in finem perducat. Atropon vero

quia verti omnino aut immutari non possit ipsum fatum.

Haec omnia eo tendunt ut et fatum causam necessario agentem significent subindeque consequentes effectus haudquaquam evitari posse. Quod et eorum de fato definitiones asserunt; est enim quam affert Chrysippus libro De providentia fati definitio eiusmodi: Fatum est naturalis quaedam series rerum omnium aliis ad alias consequentibus manente inevitabili eiusmodi connexione. Quam et Cicero libro De divinatione imitatus eisdem fere verbis expressit: Fatum id appello quod Graeci Imarmenen, idest ordinem seriemque causarum cum causa causae annexa rem ex se gignit, ea est ex omni aeternitate fluens veritas sempiterna. Fatum itaque hoc modo definitum non unam sed omnes simul causas amplectitur, a primo rerum omnium principio serie quadam per ipsos angelos, caelestia corpora, elementa omnia ad proximas cuiusque causas descendendo. Alii vero et si ordinem hunc essentialem inter causas concesserint effectrices, Fatum tamen non esse universam causarum seriem arbitrantur, sed solam siderum constitutionem et influxum, cum quid aut nascitur, aut concipitur, aut incohatur. Nec significari tantum ex ipsis quaecunque futura sunt, sed effici quoque et invehi, non in naturam tantum, sed et in corpora et animos nostros inevitabilem quandam necessitatem futurorum.

Caeterum Alexander Aphrodiseus novam quidem, nec ab aliis citatam, non tamen a veritate dissonam, physicamque potius quam theologicam fati significationem introduxit, quare nec in universam causarum seriem, nec in astrorum constitutionem putat fatum esse reducendum, sed in ipsam naturam, ut idem omnino sint natura et fatum, et quaecumque natura fiunt fato fiant, remeatque ut etiam quae fato fiunt natura fiant. Nam et fato ignis calefacit, equus equum et homo hominem generat. Haec et natura ab eisdem fiunt. Si vero aliquis dissoluto corporis temperamento moritur, fato moritur; at si ex equo praecipitatus aut gladiis confossus, non moritur fato. Quem modum et Virgilius de Didone attigit:

Nam quia nec fato merita nec morte peribat

hos est, non morte per naturam ei debita sed violenta. Ovidius quoque:

Est aliquid fatoque suo ferrove cadentem
In solita moriens ponere corpus humo.

Fato suo, hoc est morte sibi ex natura decreta. Astrologi contra in fatum maxime eiusmodi mortem violentem reiciendam putassent. Eodem pacto et Aristoteles quarto Physicae auscultationis quasdam dixit esse fatales generationes, hoc est quae secundum naturam fiunt. Cum itaque natura non necessario, sed plurimum suos effectus producat, siquidem impediri potest; nam et multa praeter naturam fiunt; ita et fatum non necessario sed plurimum suos effectus agere dicendum est, fierique multa praeter fatum ut quae nostra electione, fortuna aut casu fiunt. Nam et quae naturali adversante impulsu vi coacti agimus, praeter fatum agere dicimur, cum pugnent inter se vis et fatum, hoc ipsum Alexandro referente primo Quaestionum naturalium, cap. quarto. Non ignoravit tamen Alexander et alia praeter naturam esse agentia duo principia, deum scilicet optimum et hominem ipsum quibus minime fatum deputavit. Nam et universa Deum maximum suo consilio et providentia gubernare fatetur, totamque causarum seriem ita ab ipso pendere ut suum causandi semel sibi a Deo constitutum modum non deserant aut intermittant. Deum igitur fatum esse, aut fato agere quae agit quippe qui nullam habeat superiorem causam iure dixisse nullus potest, sed ipsum potius fati causam appellasse par est, cum et corporum caelestium et totius naturae sit causa. Corporibus quoque caelestibus non fatum sed fati causas ascripsit quatenus et ipsa inter causas agentium naturalium numeravit. Nec aliter in subiecta sibi mundana corpora agere opinatur quam per lumen et motum, quemadmodum et elementa in corpora ex ipsis composita per primas qualitates. Quare et humana corpora cum in varias affectiones et interitus proxime ad naturalem ex illis compositionem incurrant, merito fatis obnoxia dixerimus. Quod si quis affectiones has omnino necessarias fore hoc ipso nitatur ostendere quod causas habent proximas naturaliter et necessario agentes, respondebimus ipsas nihil minus vitari posse, et in contrarium habitum assuetudine permutari adhibita diligentia ex Medicorum praeceptis et victu aliisque eius generis in contrarium dispositis. Eodem modo et longe facilius convelli animi vitia et extirpari possunt quae ex corporis contagio in ipsum redundant. Hunc igitur tertio loco numeravit Alexander quem ea praerogativa et conditionis dignitate praeditum esse testatur, ut non perinde ac corpora legibus naturae devinctus sit, sed liber omnino in quam malit contradic-

tionis partem se flectat. Iccirco nec aliqua fati necessitate astringitur, nec ulli naturae, ne quidem caelestium corporum aut angelorum subicitur.

Sileant igitur qui humanas actiones in ficticias quasdam siderum posituras indirecte referendas putant. Sed et illi gravius peccant qui quod Deus ex aeternitate noverit quicquid acturi sumus id nos coacte et necessario arbitrantur acturos. Si enim nos Deus liberos esse voluit, quicquid egerimus libere agemus, quoniam id nos Deus libere facturos praevidit. At certe liberos homines esse constitutos vel inde maxime notum esse potest quod hominis essentia in ipsa rationali natura sita est quae nil aliud est quam vis quaedam et principium homini innatum quo aliquid aggredi potest et non aggredi, et opposita pariter; non quod ab externis causis ipsum ad id cogentibus impellatur quemadmodum bruta quae etsi sponte quaedam subterfugiant, quibusdam inhaereant, quoniam tamen a visis impulsa, non a ratione moventur, libere ad haec ipsa moveri nullus dixerit.

Haec sunt, Comes integerrime, quae de Fati nominibus et Alexandri opinione erant mihi declaranda. Reliquum est quod etiam per initia diximus, ut insignem hunc Alexandri tractatum a me in Latinum conversum tuoque nomini creditum amplectaris et foveas; quod si feceris, plurimum certe illi et dignitatis et ornamenti attuleris.

VIII,*b*,4. *De fato.* Translation of Gentianus Hervetus, here cited from the single edition: Lugduni, apud Aegidium et Iacobum Huguetan fratres, 1544.

Christianissimo Francorum Regi Francisco, Gentianus Hervetus Aurelius S.

Si tua in summa omnium rerum potestate insignis humanitas ex constantissimo omnium sermone mihi satis nota non esset, Christianissime princeps, non ausus essem hoc Alexandri Aphrodisaei opusculum nuper a me Latine versum tibi consecratum offerre. [Hervetus praises Francis I for his learning, and he compares the king with the emperors addressed by Alexander in the *De fato.* Hervetus particularly praises Francis for his courteous treatment of his strongest enemy, at a time when he might have seized the occasion to make gains in Flanders. 400 wds.] Ad hoc autem vertendum opusculum hoc me non parum incitavit, quod id mihi sit visum huic tempori convenientissimum. Nam cum non multis abhinc annis vel exorta, vel ab inferis excitata, nefaria quae τῶν ἀθέων dicitur, secta, qui ut plurima maxime impia et execranda praetermittam, hoc quoque constantissime asserunt omnia fato, et inexorabili causarum necessitate geri, et nihil esse penitus in nostra potestate, quae autem ex sacris scripturis, aut earum interpretibus afferuntur, rationes, et testimonia penitus reiiciunt, operae pretium mihi facturus visus sum si, quae ad eorum convellendam opinionem ab Ethnicis scripta sunt, in medium afferrem. Inter quos primas partes tenere Alexander Aphrodisaeus optimus Aristotelis interpres mihi non, ut arbitror, immerito videtur. Quod quidem eo libentius suscepi, quod res a te praeclarissime gestas quosdam ita tractare conari animadverterim, ut eas omnes fatis tuis, iisque asperrimis tribuant. [Hervetus illustrates the proper approach to the king's great achievements, including his winning back Milan from the Swiss at the beginning of his reign. 300 wds.] Ad hanc veram et piam suscipiendam opinionem cum mihi hic libellus plurimum collaturus visus esset, eum in linguam Latinam versam, augustissimo tuo nomini dedicavi. Quem utinam tam benigne suscipias, quam tibi penitus devoto studio ab eo missus est, qui, ut Christus servator noster, te, et omnia tua perpetuo fortunet, assiduis votis sollicitat. Vale Christianissime Princeps.

Lugduni X Calend. Decembris.

IX,*b*,2. *De intellectu.* Translation of Hieronymus Bagolinus, here cited from the single edition: Veronae, ab Andrea B.C., impendio interpretis, 1516. The preface is reprinted in R. Lemay, *op. cit.* (see VIII,*b*,2 above) p. 462–463. A variant form of the preface is found in Ms. Vat. Lat. 4565; on this, see the *Catalogus Translationum.*

Hieronymi Bagolini Veronensis In interpretationem Alexandri Aphrodiesei De intellectu Ad Ioannem Batistam Turrium Veronensem praefatio.

Enarrationem Alexandri Aphrodisei de trino intellectu ex Aristotelis placitis, angustis verborum limitibus clausam, sed sensibus effusam et quaestionibus perquam arduis uberem, iampridem a me in Latinum conversam tibi, Joannes Baptista, dicare constitui, simul ut amorem praecipuum observantiamque non vulgarem qua excellentissimos olim et omni doctrinae et morum laude cumulatissimos Hieronymum patrem tuum et Marcuum Antonium fratrem semper sum

prosecutus, viventi tibi munusculo hoc utcunque contester, quamvis sciam eximia eorum erga me beneficia praemia medius fidius longe maiora sibi promereri [promeriti], simul ut Alexandri opinionem de intellectu quam dum in Gymnasio Patavino naturales disciplinas publice profiterer, eruditissimo fratri tuo, frustra tamen, examinandam pensitandamque tradere decreveram, cum morte intempestiva nobis surreptus fuerit, tu qui eius locum doctrina, eruditione, moribus et virtutibus subiisti, ceu hereditario iure tibi debitam perlegas, et ex ingenii acie perpendas an ex Averroes sermone perplexo vel ex ipsa Alexandri mente certius et intemeratius possit agnosci. Quando quidem te non ignorare certo scio eiusmodi interpretationes, quas de rebus Graece scriptis ex Arabum lingua Latini mendicavere mendosas et veritati adversas magna parte inveniri. Qualem et mihi ipsius huius opusculi De intellectu, incerto interprete, his diebus a me numquam ante animadversam vidisse contigit. In qua praeter elocutionis involutam seriem errata non multo verbis pauciora ab ipso statim limine ad calcem usque sese legentibus nobis obtulerunt. Quae in medium afferre supervacuum duxi, cum nostram cum illa collaturis, notissima fore mihi persuadeam. Ita evenit ut quam me ab instituto submoturam suppresuramque verebar, contra potius ad huius nostrae editionem praecipitem [praecipientem] impulerit, cum eam studiosis omnibus non inutilem futuram cognoverim.

Ceterum, mi Joannes Baptista, quicunque hanc nostram interpretationem adituri sunt, hoc loco monendos censeo, ne in huiuscemodi genere interpretandi res physicas, quod profecto ex omnibus arbitror difficillimum, verba expectant nova aut translaticia, et nullius ante trita solo, ut ait Lucretius, neve ornatam nimis aut perpolitam orationem concupiscant, sed quae modo non sit rudis aut barbara, integrum autoris sensum aperiat. Ne quid desit, ne quid supersit, ne quid subsultet [subfulet], ne quid immutetur. Quem modum Boetius Severinus servavit, et nos quoque servamus et servandum fatemur.

Quamquam non ignoramus summusores plerosque affuturos qui nostra haec incessere coarguereque non desistant, sed nos eiusmodi hominum detractionis, cum grammatistae potius quam philosophi habendi sunt, parvi facimus, modo abs te aliisque qui non nudos (ut aiunt) cortices, sed rerum scrutantur praecordia, exquisitae doctrinae iudicio perspicaci probari haec ipsa percipiam.

XII,*a*,1. Quaestiones Alexandri Aphrodisiensis Naturales, De Anima, Morales.... Venetiis, B. Zanetti, 1536.

Petro Danesio Victor Trincavelus S.

Ea sunt officia, Danesie optime pariter ac doctissime, quibus tu me arctissime devinxisti, ut profecto illiberalis et ingratus sim, nisi et te plurimum diligam, et tibi me plurimum debere fatear. In ea enim provincia, quam in gratiam et utilitatem literatorum hominum suscepimus, Graeca monumenta praestantiorum authorum quae hactenus in tenebris et pulvere non sine studiorum iactura latuerant, formis quam fieri posset melius, excudendi, tu mihi, tum in aliis quae iam a nobis edita sunt, cum in Alexandri quaestionibus, quae ad calcem perductae, ad editionem properant, eam operam et auxilium impertitus es, ut quicquid studiosi bonarum literarum ex nostris laboribus se profecisse senserint, id vel maxime tibi debeant.

Quamobrem iure mihi merito Aphrodisiensis, non tantum ob operam quam tu diligentem admodum ut illum suae pristinae integritati restitueres, impendisti, quantum ob tui ingenii felicitatem eruditionisque praestantiam, quibus tu illi similis admodum evaseris, qui inter Aristotelicos expositores omnium fere consensu primatum sibi vendicaverit expetere videtur, ut tui nominis particeps factus, et tibi dictus in manus doctorum hominum prodeat, cum non parum sit tibi ex tuo patrocinio gratiae apud bonos et eruditos homines, qui omnes prae tuis virtutibus te plurimum et amant et colunt, accessurum. Sub tuo itaque nomine et tuis felicibus auspiciis Alexandri Quaestiones edemus, quibus tamen ut in iustum volumen excresceret, alios elegantes et utiles libros hinc inde conquisitos, et a ruina et interitu erutos, adiunximus. Quare tu huiusmodi viri patrocinium, quo semper plurimum delectatus es, suscipe, et me ut facis, semper ama. Vale.

XII,*b*,1. *Quaestiones naturales* I, 4; II, 21; and III, 13. Translation of Hieronymus Bagolinus, here cited from the single edition: Veronae, ab Andrea B. C., impendio interpretis, 1516. The preface is reprinted in R. Lemay, *op. cit.* (see VIII,*b*,2 above) p. 463–464.

Hieronymus Bagolinus lectoribus.

Quam arduum sit, eruditi lectores, Latinis hominibus quae in aliena et peregrina lingua didicerint in suam sibique cognatam transferre

quamque difficile primum interpretari Graeca deinde physica ubi praecipue non elocutionis tantum ratio habenda est, sed et rerum natura servata ipsaeque nominum notiones ad unguem exprimendae, nemo est certe qui rectius scire possit, quam qui utramque probe calleat. Sed id qui fieri potest, nisi in utraque quis natus aut a teneris saltem educatus fuerit inque [in qua] legendis diversorum auctorum operibus quocunque genere quacunque materia iuciter versatus diutius insudaverit [insudaverint]. Hinc arbitror evenisse ut ad hoc aevi quantum ipse noverim nullus hoc interpretandi munus tam feliciter sit aggressus, tam exacte et citra mendam exercuerit, ut invidentium calumnias et latrantium morsus evitare potuerit [poterit]. Quapropter non defuere qui consulerent ut Graecis Graeca, Latinis Latina perscrutanda relinquerem [relinquem]. Fuitque demum, testor, diu is animus mihi, ut hanc Graeca exponendi provinciam omnino non attingerem, cum ex ea plus laboris quam laudis, plus detrimenti quam ornamenti consequi datum sit, vel ea praecipue de causa quod si quis inter legendum in codicibus Graecis qui e Graecia in Italiam plurimum mendosi devenerunt error aliquem offenderit, non autor aut scribentium incuria, ut par esset, sed interpres accusari solet. Haec me praeter ceteras potissimum in Alexandri De fato editione ancipitem reddidit, cum in eo innumeros errores et ex his non paucos paene inextricabiles in omnibus exemplaribus invenerim, ab aliis alioquin eruditis viris pernotatos, nec tamen emendatos certo sciam. Ex his plerosque sanasse aut modum quo sanari possent, ostendisse nos credimus, tum ex sensuum consequentia, tum ipsius rei de qua agitur indicante natura, tum ex aliis quibusdam capitibus hanc ipsam materiam pertractantibus quae ex eiusdem Alexandri libris Quaestionum naturalium ad huius libelli De fato lucidiorem expositionem subnectenda censuimus, quibus easdem opiniones quas libro De fato insectatur, et fere fusius declarat. Illos vero qui in integrum restitui non potuerunt, qui fere uno capite decimo octavo visuntur, ne plus iusto nobis arrogaremus, ut iacent, nullo dempto aut addito sumus interpretati, unicuique pro viribus ingenii examinandos destinantes. Sed et si haec et alia eius generis multa ab Alexandri editione nos dissuaderent, superarunt tamen amicorum preces, quorum amore et utilitate compulsi, periclitari non sine Phamae dispendio voluimus ad illam festinantes. In cuius politura et ornatu non diu laboravimus, quandoquidem non ad eloquentiae fastum sed ad rei sinceram veritatem aperiendam studuimus. [Bagolinus doesn't expect to please all. 75 wds.]

XII,*b*,3. *Quaestiones naturales.* Translation of Hieronymus and Johannes Baptista Bagolinus, first published: Venetiis, apud Hieronymus Scotum, 1541, and here cited from the edition: Venetiis, apud H. Scotum 1546.

Johannes Baptista Bagolinus Veronensis, Hieronymi Filius, Vincentio Madio Brixiano Philosopho, S.P.D.

Magnam esse vim propinquitatis et similitudinis animorum rerumque omnium, sicut ante sentiebam, sapientissime idemque mihi amicissime Vincenti, ita nunc ea ipsa vi factum est, cum Aphrodisiensis Alexandri Naturales et morales quaestiones, a patre olim inchoatas, a me nuper in Latinum plene conversas emissurus essem, ut eas in nomine emitterem tuo, nempe pro tuorum cum scriptis Alexandri consensu dictorum, pro nostrarum coniunctione voluntatum. Cum enim eodem tempore et te audirem, et Alexandro operam vertendo darem, magnis in rebus, difficillimisque in philosophia locis illae mihi ipsae sententiae, eadem inventa utriusque videbantur, sive quod ex te idem ipse sentires, ut acute soles, et perspicue iudicare, non temere, sive quod Alexandrum legisses accurate, ut versaris in veteribus Graecis omnibus magis viris illis, non philosopho quovis inepto, sive quod utrumque et, cum optime sentires, placeret Alexander tibi, et cum Alexandrum studiose legeres, optima quaeque ex illo depromeres; neque id mihi modo, sed permultis aliis etiam, iisque doctis tuis auditoribus cum tua summa laude videbatur. Nostra autem coniunctio, Vincenti, non vulgaris. Primum enim apud patrem meum, dum viveret, non tu discipulus modo, sed paene filius, quod tu assidue praedicas; illo deinde mortuo, non tu magister modo meus in doctrinis, sed actionibus, vita, quod ego testor, cum tu non in contemplando solum, verum etiam agendis in rebus consilio valeas, atque prudentia; tum vero iidem mores, eadem fortuna, eadem res inter nos omnes; ea praetero, quae magnam vim habent, quibus tam multa saepe tribuimus nobilitatem, opes, potentiam, quae sicut ea sunt apud te, ut eorum causa in amplissimo honore esse posses, ac mihi et amicis cum splendore patent honestis, ita ab illustrioribus tuis orna-

mentis obscurantur; virtus autem ea tua est, ut tibi vel ipsa sola in primis devinctus esse possim. [Bagolinus continues with praise of Madius. 100 wds.] Addo enim nonnihil merito, quod res tuo magna ex parte suscepta consilio, magna tibi debebatur ex parte.

Alexander autem, optime nosti, quam corruptus Graece circumferretur, admirabilis auctor in philosophia, miserabilem in modum mendosus, sed ut scis, veteribus adhibitis manu scriptis exemplaribus Graecis multo melioribus, locis collatis vel in Alexandro ipso, vel Themistio, Ioanne Grammatico, Simplicio, Aristotele plurimum, mea summa industria, doctis consulendis et te in primis, Vincenti, effeci, ut plurimis in locis ante obscurum nunc clarum fecerim Alexandrum, quantum eius propria brevitas, obscura et concisa quaedam oratio hactenus a me fieri dilucidior potuit. Qua in re ita me intra Latinae linguae terminos constitui, ut Alexandri sententias conservarem in magna difficultate. Multo certe melior a me nunc Latinus exit Alexander, quam Graecus habeatur, res ut ita dicam, tua, amoris nostri pignus, labor hic meus quicunque est, in publicam philosophantium utilitatem. Quod tu factum meum cum probaris, probatum omnibus pro tua et in rebus iudicandis intelligentia, et apud omnes auctoritate putabo. Vale.

XII,*b*,4. *Quaestiones Naturales.* Translation of Gentianus Hervetus, here cited from the single edition: Basileae, per Ioannem Oporinum, 1548.

Marcello Cervino, tituli Sanctae Crucis Cardinali Amplissimo, Tridentini Concilii Legato, Gentianus Hervetus.

Quam doctus sit Aristotelis interpres, et quam pulchre et praeclare universam philosophiam suis commentariis illustraverit Alexander Aphrodiseus, nemo est in iis studiis aliquantisper versatus, qui non satis intelligat. Eius autem cum permulti extent libri, quorum plerique fere omnes iam sunt in linguam Latinam traducti, meo quidem iudicio nullus est qui maiorem philosophiae studiosis utilitatem sit allaturus, quam eius Quaestiones philosophicae, in quibus quicquid fere tam in naturae et animae contemplatione, quam in morum componendorum ratione paulo difficilius occurrit, breviter et dilucide, subtiliterque et enucleate explicatum est. Eae cum nescio quot abhinc annis in lucem Graece exissent, et mihi inter legendum dignissimae visae essent, quae omnibus bonarum literarum studiosis communicarentur, operae pretium me facturum putavi, si eas Latine verterem, ut qui Graece nesciunt, eum, aliena saltem lingua, si non tam ornate et eleganter, at utcumque tamen loquentem intelligerent. Is est enim Alexander, cuius si vel sensus tantum percipiatur, non parum sit vel ad parandam, vel ad confirmandam eruditionem collaturus.

Quamquam ego quidem in eis quaestionibus vertendis sedulo dedi operam, non solum ut sententiam, sed et verborum proprietatem ac dignitatem, quoad eius fieri potuit, exprimerem. Quod quidem quam sit difficile, ii demum sciunt, qui in vertendis ex aliena lingua libris studium posuere. Ego quidem certe sensi experiundo, non cuiusvis esse hominis, ex bene Graecis, bene Latina reddere, et maxime in rebus philosophicis, in quibus lingua Latina alioqui locupletissima, mirum est quanta laboret verborum inopia. Porro autem cum eas a me Latine versas, in lucem edere statuissem, et tibi pro summo tuo in bonas literas ac disciplinas amore et studio, id non iniucundum fore existimassem, sub felicissimis tui nominis auspiciis emittendas censui. [Hervetus dedicates the work to Cervinus because of the latter's encouragement toward the discovery and publication of the great writings of the past. 100 wds.] Vale. Tridenti.

XV,*a*,1. *Alexandri Aphrodisiensis, In Sophisticos Aristotelis Elenchos Commentaria,* Venetiis, apud Aldum, 1520.

Hieronymo Canossio Abbati Meritissimo, Hercules Gyrlandus Bonam Precatur Valetudinem.

Qui vere amant, Hieronyme Musarum alumne, hi numquam nec longa temporum intercapedine, nec immenso locorum interstitio, neque etiam mobilibus fortunae instabilis erroribus, nec quovis alio humanae imbecillitatis turbine, ab amatis deficere possunt. [Gyrlandus praises love. He cannot adequately express his love for Hieronymus.] 350 wds. Non hercle sum immemor, Hieronyme, quam multa de te tuaque domo retulerim bona, nam cum tuos apud lares tecum una permultos agerem menses, ubi paribus certatim Aristotelicae disciplinae studiis exercebamur, tu tuique celeberrimi parentes, ac universa tua domus, ea me grati animi pietate tractastis, eo me studio prosecuti estis, eis me beneficiis condonastis, ac me demum tantis tam

fortunae quam animi bonis affecistis, ut quidquid in me est, quidquid ego sum, id splendidae Canossiorum domui semper acceptum ingenue referam. [Gyrlandus offers Hieronymus the best he has, his edition of Alexander. 300 wds.] Quod enim maius tibi darem, pro tempore habui nihil, at, Deus optimus meis audacibus annuat coeptis, spero fore, ut propediem hunc eundem in Priora analytica et in multa alia Philosophi opera Alexandrum habeas. Mox etiam probatissimos quosque in universam philosophiam interpretes ad commune omnium commodum excudemus. Esto bono animo, Hieronyme, non enim prius (Dii faveant) destiterimus quam omnem prorsus barbariem ad corvos profugarimus. At interim lege Alexandrum et me tibi tuaeque domui addictum et fove et ama. Sis felix.

XV,*b*,2. *Commentaria in Aristotelis Sophisticos elenchos.* Translation of Guilelmus Dorotheus, here cited from the single edition: Venetiis, apud H. Scotum, 1541.

Marco Maurocoeno Senatori Veneto Doctorique Excellentissimo Guilelmus Dorotheus Venetus Salutem.

Summa vel erga patriam patritiosque meos pietas, vel in studiosos eiusdem benevolentia facit, Marce Senator et doctor ornatissime, ut ipse haud secius multo quam ille philosophus quondam face bonos, explorem civitatis nostrae literatos, quibus elucubrationes Graecorum interpretum in Aristotelem a me primum Latinas editas nuncupem. [Dorotheus discusses the importance of literature in preserving the memory of good and bad actions; this is a topic which he had recently discussed with Hieronymus a Ferro. 500 wds.] Hos igitur fructus hisque multo maiores pariunt monumenta literaria, unum praeter caetera mihi etiam efferunt commodum, ut me dudum in tuo obsequio tuaque amicitia receptum confirment. Equidem omne studium meum et curam collocavi, non modo transferendi Graecos, sed etiam conciliandi mihi complures bene moratos patritios et doctos, quibus meos labores inscribere merito possem, Quod consilium cum Octaviano amicissimo meo (ut nosti) aperuissem, te mihi virum eloquentem, vere literatum, verissime amicum oblatum esse voluit, cui has nostras translationes Alexandri interpretis Elenchorum Aristotelis primum inscriberem, quod sane eo libentius feci quod te studiis nostris Patavii deditum ab adolescentia intellexi. Nec me fallit pro doctrinae tuae excellentia, pro virtutibus tuis, pro meritis vel optima erga me voluntate, ut tanti aestimem te, quanti amicorum quemlibet. Bene vale.

XV,*b*,3. *Commentaria in Aristotelis Sophisticos elenchos.* Translation of Johannes Nabascuensis, here cited from the single edition: Parisiis, apud Simonem Colinaeum, 1542.

Gabrieli Agnuesio, Sancti Seruatoris Leirensis Abbati Dignissimo, Ioannes Nabascuensis, S.D.

Saepe apud me cogitavi, praesul ornatissime, rationem aliquam inire, qua tibi significarem, me in eorum esse numero, qui tuam dignitatem tueri cupiunt, ostenderemque amicitiam illam, ad quam me olim puerum puer et ipse admittere dignatus es, tam alte in nobis finxisse radices, ut tanto tum temporis tum loci spatio, quo seiuncti sumus, non modo non fuerit imminuta, verum accessionem non vulgarem fecerit. Dum igitur in hanc rem inveniendam sollicite incumbo, commentarii, Alexandri Aphrodiesiei in libros Elenchorum Aristotelis, a Dorotheo iam pridem Latinitate donati mihi offeruntur, ut ad Graecum exemplar conferendo expenderem, num essent aliqui errores, vel vitio interpretis vel typographorum admissi, et illos obelisco notarem. Id dum facio, myriades errorum mihi extitere, quamobrem necessum esse duxi, non tam mendas eximere quam totum opus a principio ad finem usque retexere. Caeterum ea res liberum prorsus animum requirebat, et tempus admodum logum, quorum utrumque ego destituebar, nam in privatis studiis impeditus cum essem, licebat mihi succissivis tantum horis huic rei vacare, et typographus, cum excudendi librum hunc studio arderet, parum temporis mihi concedebat. Quare coactus sum, paucis diebus hoc opus cursim perlegere, et sic mutare, quae non satis Alexandri et Aristotelis mentem reddere videbantur. Quae nec adeo pauca erant, nec adeo vulgaria, ut non infinitis propemodum in locis, lectorem vel mediocriter eruditum partim vexare, partim in falsam sententiam inducere potuissent, id quod conferenti libros a nobis recognitos cum Dorothei versione Venetiis excusa facile liquebit.

Hoc tamen cunctis persuasum vellem, non posse hos libros Latine verti, quin multa Latine prolata, suam gratiam et ἐνέργειαν amittant, et nonnulla nihil minus quam Aristotelis mentem explicent. Suffragatur nobis hac in parte doctissimus Erasmus, ut ad marginem interdum notavi.

Nos exempla nonnulla mutavimus, ut Aristoteles redderetur apertior; id frequentius fecissem, nisi quod interdum, mutatis exemplis, non pauca ex commentariis erant rescindenda, ut videre licet in exemplo illo Homeri, quo utitur Aristoteles ubi de fallacia disserit, quae propter accentum fit. Quo loco miror interpretem carmina Vergilii et Horatii reiectis Homericis posuisse, praesertim cum videret, exemplum illud Homeri prolixa oratione ab Alexandro declarari. Aliis in locis quaedam Graece reliquimus, sed quae vel ab ignaro literarum Graecarum intelligi possint, nam in margine, si quid est difficultatis, explicamus. Hanc nostram operam, quantulacumque est, tibi nuncupare volui, ornatissime praesul, ut si qua utilitas ex ea ad studiosos pervenerit, eam tibi acceptam ferant. Quod illi merito facient, quandoquidem amore tui ductus hunc laborem subivi. Vale, praesul humanissime, et hoc munusculum velut signum amoris, quo te persequor, accipe.

XV,*b*,4. *Commentaria in Aristotelis Sophisticos elenchos*. Translation by Gaspar Marcellus, first published Venetiis, apud H. Scotum, 1546, and here cited from the edition. Venetiis, apud H. Scotum, 1559.

Illustrissimo D. D. Nicolao Rodolfo Ecclesiae Romanae Diacono Cardinali Maximo, Gaspar Marcellus Montagnanensis Philosophus Patavinus, bene et recte perpetuoque agere D.

Quantum Aristoteli philosopho, vir amplissime Nicolae Rodolfe Cardinalis Maxime, hominum genus debeat, nemo unus qui progressus in literis vel modicos fecerit quive artium studia modice coluerit ambigere potest, isque qua cura, qua diligentia, qua industria, quo animi affectu non rem Romanam, non Christianamve publicam, sed humanam non aliquo tempore sed omni in aeternitate naturam iuverit, non ignorabit. [Marcellus praises Aristotle at length, particularly for his efforts to educate all ages and types of men. He considers Aristotle's logic as of special importance and emphasizes the excellence of Alexander's commentaries on the logical works. 1,500 wds.] Cuius [sc. Alexandri] doctrina hac in re, ut in aliis maximis, mirum me in modum delectare visa est, et ut nihil eius me fugere posset, in Latinam Graecam eius viri orationem vertere volui multa, quae legentem fortassis me fugissent, transferentem latere non potuere, simulque illud accidit, ut Graecarum literarum ignaris rem cum non iniucundam, tum non inutilem facturus sim. Itaque sub tuo nomine, velut divinissimo numine, Alexander e Graecia in Latium ut prodiret, adnixus sum.

In quo transferendo meas duxi esse partes viri sententiam claram, sensum planum, facilem, integrum reddere et non verbis obscuris ab usuque remotis, velut ex aboriginum libris atque longe ab antiquitate petitis, sed obviis, consuetis et huic arti peraccommodatis uti, omni eorum reiecta curiositate quae rerum scientiae non parvam (ut inquit Platonicus hospes) in senectute iacturam curiosis inferre solet. [Marcellus praises Rodolfus and hopes at the end for his elevation to the papacy. 700 wds.]

XV,*b*,5. *Commentaria in Aristotelis Sophisticos elenchos*. Translation of Johannes Baptista Rasarius, here cited from the single edition: Venetiis, Ludovicus Auancius excudendum curabat, 1557.

Ioannes Baptista Rasarius Matthaeo Donato Aloisii filio S.P.D.

Cum iis bonis, quae mortalium generi deorum concessu atque munere data sunt, nullum optabilius nullumque praestantius unquam sit habitum quam philosophia, non possum non magnopere sententiam tuam, Donate, commendare, qui postquam poetis, atque oratoribus summo studio operam antehac dederis, non contentus ea, quae in te elucebat humaniorum literarum cognitione, animum ad libros Aristotelis adiunxeris. Videbas enim ad rerum omnium cognitionem viam tibi hac ratione quodammodo commonstrari, et aditum ad vitae humanae atque civilis pracepta patefieri. Itaque existimasti, ea tibi percipienda esse in primis, quae ad artem iudicandi et inveniendi pertinent, ut hoc quasi instrumento adiutus facilius ad naturae cognitionem, et rerum divinarum contemplationem certa via pervenires, ut demum in luce huius maximae reipublicae summa cum laude versareris. Quam ob rem ardenti quodam studio concitatus tantos in disserendi facultate progressus fecisti, ut iamiam ad librum perveneris Elenchorum, cuius sententiam rite ut assequaris, Graecorum interpretum explicationem non secus, quam in ceteris fecisti, tibi adhibendam esse iamdiu perspexisti. Sed audiebas commentarios, qui Graece in Elenchos scripti sunt, plerisque locis esse depravatos sic, ut nullus persaepe sensus eliciatur. Cupiebas autem mirum in modum ut, quoniam ego, cum in hoc studio incumberem, eos Latinos feceram

et cum manu scriptis codicibus contuleram, quae meo studio ac labore essem consecutus, non paterer latere diutius, sed quoniam plerique essent Graecarum literarum ignari, qui tamen excellenti ingenio disciplinis se dedant, ad eorum utilitatem meam interpretationem ederem. Ego vero quamquam mihi olim hanc confeceram, nec de ea in apertum proferenda cogitarem, tamen tibi hoc negare nullo pacto potui. [Rasarius indicates his great respect for Matthaeus' father and for Matthaeus himself. 250 wds.]

Venetiis, pridie Calen. Sext. MDLVII.

XVI,*b*,1. *De febribus*. Translation by Georgius Valla, here cited from the first edition: Venetiis, per S. Papiensem, dictum Bevilaquam, 1498.

Georgius Valla Placentinus Magnifico Equiti Iurato Georgio Cornellio Veneto Senatori Sal. dicit aeternam.

Cum sua cuilibet, Georgi Cornelli Venete Senator inclyte, natura tribuit animanti, ut suum suorumque corpus tueantur salubria disquirendo vitandoque contraria, ut brutae etiam pleraeque corporis medellas inveniantur [inveniant] tam ferae quam cicures sibi comparare. [This is particularly important for men, notably for those who rule other men, and fever is among the most common and dangerous of illnesses. Valla send his translation of the *De febribus* to Cornellius. 200 wds.] In tota siquidem civitate non potuit melius nancisci peregrinus hospitium, quod tantis doctrina viris non nisi inclyta regiaque conveniat (?) hospitia, quale tuum, cuius Cypri regina soror est. Quod si disputandi de summis scientiis desiderio tenebitur Alexander, de tribu quoque Cornellia Antonium habuerit doctissimum et singulari probitate eminentem, ut iam in Cornellia domo nihil desiderari potuerit. Hunc ergo, inclyte Georgi Cornelli, a me tibi habe conciliatum, ut omnes doctos habere consuesti. Vale.

XVII,*a*,1. Aristoteles, *Opera* (with works of Theophrastus and the *Problemata* attributed to Alexander), 4 vols. in 5. Venetiis, apud Aldum, 1495–1498. The *Problemata* are found in vol. III, with a special Preface. The Preface has been reprinted in B. Botfield, *Praefationes et epistolae editionibus principibus auctorum veterum praepositae* (London, 1861) p. 202–203.

Aldus Manutius Alberto Pio, Principi Illustrissimo, s.p.d.

Plato philosophus interrogatus, Alberte, Princeps illustrissime, *πῶσ ἂν ἄριστα διοικῶνται αἱ πόλεις* respondit. *ἐὰν οἱ φιλόσοφοι βασιλεύσωσιν ἢ οἱ βασιλεῖς φιλοσοφήσωσιν*. Verum ac sapiens responsum, et Platone dignum, principe Academicorum. Optime enim gubernarentur respublicae si aut philosophi regnarent, aut principes philosopharentur; non tot rapinas, tot caedes, non foedissimam tetramque luxuriem, non cetera nefanda flagitia impune aspiceremus. Nic dubito quin cum dico philosophos, eos intelligas qui sancte, qui vere, qui integerrime, ut tu facis, philosophantur: non quosdam indoctos primum, hinc pravos et haereticos, ac potius nulli addictos religioni, qui nomine tantum sunt non etiam re philosophi, quique de virtute locuti — at cetera non nobis sed satyro liceant. Nec mirum tales ex pecudum magis quam ex hominum genere, non posse candidas disciplinas aureamque virtutem attingere. *Μὴ καθαρῷ γὰρ καθαροῦ ἐφάπτεσθαι ὀυχὶ θεμιτόν* ut ait Plato. Cum tu igitur, princeps, unus ex paucis, quos aequus amavit Jupiter, acerrime philosopharis, hos etiam de Philosophia libros in tuo nomine publicare constitui. [Aldus lists the works contained in the volume. 75 wds.] Illud certo scias cum ceteris studiosis, omnia a nobis in dura hac et sumptuosa provincia fieri accuratissime. Quod sicubi non factum videbitur, quod quaedam dari meliora potuerint, videte ne sitis ingrati, cum nocte dieque vel supra vires vobis laborem: quod tamen facio perlibenter, nec ab incepto unquam desistam, nisi effecero quod sum pollicitus. Nullis profecto parcam sumptibus quamvis magnis, parvifaciam labores omnis, etiam si in voluptate vivere et in otio esse semper possim. Es enim tu mihi optimus testis an potiores

> Herculis erumnas credam, saevosque labores,
> Et venere, et coenis, et plumis Sardanapalli.

Natus enim homo est ad laborem, et ad agendum semper aliquid viro dignum, non ad voluptatem, quae beluarum est ac pecudum. Optime tu igitur princeps Herculem Jovis satu editum imitaris, qui cum primum pubesceret, quod tempus a natura ad deligendum quam quisque viam sit ingressurus, datum est, duas cernens vias, unam virtutis alteram voluptatis, virtutis ingressus est viam. Quare perge tu philosophari, ut coepisti, sisque exemplo ceteris *ὡσ φιλοσοφούντων τῶν βασιλέων ἀριστα διοίκοιντ' ἂν αἱ πόλεις*.

XVII,*b*,2. *Problemata.* Translation by Theodorus Gaza of 1453, first published Venetiis, apud Aldum, 1503–1504, here cited from the edition: Venetiis, apud Aldum, 1513.

Theodori Gazae Thessalonicensis in Problemata Alexandri Aphrodisiei ad Nicolaum quintum pontificem maximum, Praefatio.

Num aegre interim feras, Pater sanctissime, si ego falsam deprehendam libri descriptionem, an libros tantum illos de hierarchia autoris esse Dionysii Atheniensis viri doctissimi velis, ne quid religioni derogetur, caetera autem sint necne, quorum volumina esse inscribuntur, parum referre censeas, modo fructus ex his aliquis capiatur? Equidem ita censere te arbitror, nec vereor, ne quod hactenus per tam longum tempus crediderint homines a me reprobari videatur. Multa enim docti interdum per incuriam, indocti saepe per ignorantiam improbe credunt, et quod Thucydides autor gravissimus inquit abditam rerum veritatem nullo cum labore multitudo investigare consuevit, labitur in ea potius quae in promptu et in propatulo habentur. Problemata igitur, quae tanquam Alexandri Aphrodisiei opus convertere me in Latinam linguam iussisti, converti quidem et eo hercle libentius, quo non tantum morem me tibi gerere, verumetiam pleraque in his quoque scite discuti intellegebam, sed Alexandri illius haec, viri foecunda sapientia praediti et veri atque germani opinionum Aristotelis speculatoris, nullo pacto equidem credere possum. Nam et doctrina auctoris illius cum in plerisque aliis, tum in iis, quae de animo istaec disserunt problemata, omnino desideratur, et ab elocutione illius adeo longe haec dissonant, ut facile quisque lectione veterum literarum Graecarum exercitus intelligere possit, non id opus ad Alexandrum Aphrodisieum, sed ad aliquem multo recentiorem autorem referri oportere. Doctrinae iudex nullus te melior esse poterit, elocutionis vero, quoniam id per interpretationem patere satis non possit, si meo parum confidis iudicio, sint illi arbitri velim, qui neque per malignitatem ementiantur, neque per ignorantiam literarum gentis Graecae bonarum aberrent.

Sed quamquam Alexandri Aphrodisiei Problemata haec esse non putem, utilia tamen legendaque ita iudico, ut nec tibi converti iussisse displiceat, nec me munus hoc unquam poeniteat suscepisse. Quamobrem haec illis Aristotelis Problematibus, quae superiori anno converti tuoque dedicavi nomini, adiungenda, si placet, iubebis, ut copia larga problematum eodem codice contineatur, fructumque sic capere ex vicinio liceat ampliorem, nam et sermonis faciem talem nos scitamentis huius recentis parumque linguae periti autoris posuimus, ut ex eadem officina interpretis, ex qua illa Aristotelis, haec quoque exisse viderentur. Vale.

XVII,*b*,3. *Problemata* Translation of Georgius Valla, here cited from the first edition: Venetiis, per Antonium de Strata, 1488.

Victor Pisanus, Ludovico Mucenigo praecellenti in eloquentia viro, S.P.D.

Singularis doctrina, facundia minime vulgaris, insignisque tua prudentia, Ludovice Mucenige, me iampridem ad te amandum et observandum compulerunt. Tua porro lenitas facit, ut mutuus inter nos amor intercederet ut alter alteri cum sors ipsa tulit congratuletur pariterque condoleat sicut in praesentia mihi faciendum duco. Nam cum proximis diebus apud praeceptorem nostrum Georgium Vallam sicut de more ad eum ventitare consuevi, essem, audivi impressorem quendam, qui eius opera imprimere et evulgare consuevit, Alexandri Aphrodisei Problemata quae olim Latina fecisset ipse Georgius Valla, sibi imprimenda vehementer exigere, quod Nicoletus nostri temporis philosophorum omnium acutissimus edenda esse duceret atque magnopere hortaretur. A praeceptore quoque nostro Valla accepi idem ut faceret hortari cum multos, tum Lazarum quendam Dactylum Placentinum medicum longe praestantissimum, quem alterum nostri temporis Galenum frequenter solet appellare, ita admiranda quadam doctrina praecellit. [Pisanus read the *Problemata* and found them very good. 75 wds.]

Proinde nostrae huic congratulemur civitati, quod talem nacti fuerimus virum, qui doctrina tam multiplici et praecellenti sit, ut nostrum illustret saeculum, ita quotidie novum in omnibus passim scientiis aliquid emergit ac ut adhuc magis nostrae civitati congratulemur, hunc sublimem doctrina virum praeceptorem nostrum in diverso dicendi genere multivigos discipulis suis fructus ingerere, alii ipso dirigente rhetoricos, alii poeticos, alii mathematicos componunt commentarios, ac ut alii in Latinum Graeca convertunt, ita inter ceteros unus in dicendo minime infans historiam a prima hominum memoria ad proxima usque tempora decem et novem enneadibus conclusam in Latinum transfert, ubi praeter ea quae in toto orbe terrarum gesta sunt, videas disciplinarum non inventores modo, sed etiam quid illis subdiderint connexerintve quae

priores ingenio suo aut alieno memoriae prodiderunt, et quemadmodum ab exiguis principiis quasi per [pro] gradus ac per [pro] manus ad summum culmen omnes conscenderint disciplinae, dii immortales, quantum nobis illuxit bonum, quam multiplex ex uno viro emanat fructus et in posterum annuente Deo, unde bona omnia, futurus est.

At iam haec missa facio, si enim prosequi velim ut ipsa deposcit materia, nullus eius laudum finis inveniretur. Iam igitur ad te eius visendam in scribendo peritiam et Alexandri Aphrodisei longe praestantissimam dimitto doctrinam.

Letter II

Georgius Valla Placentinus Johanni Marliano Mathematico et in tota philosophia medicinaque praestantissimo, salutem plurimam dicit.

Alexandri Aphrodisei philosophi ac medici praestantissimi Problemata hortatu at auspicio tuo in Latinum, vir longe doctissime, Johannes Marliane, converti, quod te interpretari ea velle mihi dixisti; ipsa multis de causis tibi dicanda esse existimavi, et quod a me discipulo tuo, cum medicinam mathematicasque scientias publice profitebare, tamquam ab ea quam tu inserueris stirpe fructum aliquando reposcere iure tuo quidem videaris, ego autem vel non poscenti, si non doctissimos ut tua ingens expostularet eruditio praestare possim, at certe non ingratos merito debere tibi videar exhibere, quod me plane effecturum confido, deinde quod haec qualia sunt perpendere, ac iudicare te melius possit nemo, nempe cuius praestantis in omnibus bonis artibus doctrinae nomen, ut res etiam ipsa est, tota non capiat Italia, deinde quod hunc laborem ad te meum fructum non mediocrem filiis tuis Hieronymo, Petro Antonio, Paulo eximiae indolis in ipsis futurae eruditionis adolescentibus allaturum confido. [Valla further praises the sons of J. Marlianus. He then discusses the *Problemata* in terms of the four-fold division of medicine, and he analyzes at some length the various kinds of *problemata* or *quaestiones*. 900 wds.]

XVII,*b*,4. *Problemata*. Translation by Angelus Politianus, done before 1478, here cited from the first edition: Venetiis, apud Aldum, 1498.

Petrus Crinitus Io. Francisco Pico, Mirandulano Principi, S.D.

Hactenus in eo fuit, Mirandule princeps, ut Politiani Problemata ex Alexandro Aphrodiseo, putaverim supprimenda potiusquam in vulgus emittenda. Neque id adeo, quod opinatus sim usquam haud ita parum in illis Politiano elaboratum. Sciebam quidem, qualiscunque sit his demum genius, ob id Latinis tradita, ut legi, composita, ut probari possent, quamquam enim legent haec quidam, ut litigent, multi magis ut improbent, quibus et plerumque consentiunt improbi, probi non idem. Verum cum id opus a Theodoro Gaza primum, quod tum in pontificis bibliotheca, tum alibi visitur, deinde a Georgio Valla diu post sit interpretatum, veritus sum, ut dignum satis operae pretium videri posset, si tuis quasi auspiciis in lucem conspectumque promeretur. Sed ventum ad id est, ut omnem in hoc ego lapidem, veluti in causa mos olim coniecturali, amoveam, id et veterum adeo exemplis, et Ioannis Maynardi suasu. Hic enim qua est in philosophiae sacris, vel auctoritate vel religione fecit, ut bonis me iuvenibus consultum iri putem, si labor hic quoque Politiani velut ex asse rependatur, quin et studiosorum ingenia ex collatione multiplici variaque interpretatione certius in his quiddam, et ut dicebat Hieronymus excultius assequentur. [Crinitus lists some ancient parallels to his procedure. He notes refusal of Theodorus Gaza to accept Alexander's authorship. Politianus would have improved the translation had he lived longer. Crinitus lists some other works included in this edition. 150 wds.] Parum moror, si et illud in calce Plutarchi Cheronensis Amatorias adiecimus narrationes ad Pandolfum Collenucium, qui adeo Politianum suspexit, adeo eruditionem eius observavit, ut nostrum quoque studium (quid enim hoc negem?) propemodum ut alumnum se agnoscere profiteatur. Vale.

Kalendis Aprilis, MCCCCL XXXXVII,
Florentiae.

XVII,*b*,5. *Problemata*. Revisions and additions to the Theodorus Gaza translation, and a revision of the Aldine Greek text. Here cited from the single edition: Parisiis, sumptibus E. Tussanae, 1540–1541.

Illustrissimo Principi, Ioanni, Cardinali Lothoringio (!), Ioannes Davionus, S.P.D.

Cum superiori tempore physica medicaque problemata Alexandri Aphrodisiei nomine publicata diligenter Graece relegissem, et animadversa interpretum varia lectione, atque ex paucis

quibusdam fragmentis exemplaris manu scripti Aldinum codicem passim emandassem, efflagitarentque diu multi philosophiae et medicinae studiosi, ut libri mei copiam typographis facerem, iustis illorum flagitationibus tandem aliquando acquiescere, aequum esse iudicavi, scriptis in margine libri annotationibus, sicubi de ipsa authoris dictione dubitarem. Cum autem ingenii mei quanticunque vim totam in ea re consumpsissem, Iacobus Tusanus professor regius, homo linguae Graecae longe peritissimus, pro sua in me benevolentia et pietate suscepto de coniecturis meis iudicio, plerisque mutatis ipsam dictionem integritati suae restituit. Porro autem ut illis qui Graece non norunt aliquid conferrem, Theodori Gazae interpretationem a mendis complurimis vindicavi, et quae mihi ipse visus est obscurius vel alienius exposuisse, ego illa conatus interpretari facilius aut magis apte, in margine ex opposito modice ac parce annotare operae pretium duxi, nota huiusmodi* designata. Quae autem animadverti inter illas quas idem Latinas fecit quaestiones esse ab ipso praetermissa et ad rei illustrationem aliquam pertinere, existimavi non inutile suis locis [inter similes notas] apponere. Quae vero problemata idem interpres, usus proculdubio exemplari dissimili, in totum omiserat, etsi Angelus Politianus nonnulla quidem, Georgius autem Valla omnia Latinitate donavit, tamen quia ille alicubi non ita bene, hic passim inepte interpretatus est, ea accuratius elaborata retuli, in suum quoque ordinem et locum, apposito tali ☙ indicio.

Has qualescunqumque studiorum meorum primitias, Illustriss. Princeps, ideo visum est mihi sub tuo nomine in vulgus edere, quia e republica esse putavi, summam in literas per te inceptam animo ingenuo regioque exemplo liberalitatem, quam etiam ad me voluisti pertinere, omnibus fieri manifestam. [Davionus praises the Cardinal for his generosity in the restoration of schools, and he relates the purpose of schools to that of the ancient monasteries. 300 wds.]

INDEX OF NAMES

The following index lists all names of persons found in the cited portions of the prefaces or appearing in the summaries. It is therefore complete for contemporaries and omits only ancient figures mentioned in the summarized sections and not taken into the summaries. The index uses the Latin form of names, but for contemporaries a vernacular form is regularly added in parentheses.

The abbreviations used are:

ded = person to whom the dedication is addressed

ed = editor of the work in question.

tr = translator of work in question.

Very brief biographical and bibliographical information has been added for contemporaries. The following works are cited in abbreviated form:

Enc. ital. = *Enciclopedia italiana*, 36 vols. (Rome, 1929–1939).

Ferrari = L. Ferrari, *Onomasticon. Repertorio Biobibliografico degli Scrittori Italiani dal 1501 al 1850* (Milano, 1947).

Tiraboschi = G. Tiraboschi, *Storia della letteratura italiana* (Venezia, 1823–1825).

Aeneas, VII,*a*,1.

Agnuesius, Gabriel (Anuesio, G. ?), XV,*b*,3 (ded). Fl. first half of sixteenth century. Abbot of San Salvador in Leyre, Navarre. Known to me only through this preface.

Alexander Aphrodisiensis, *passim*.

Ammonius, I,*b*,2; VI,*b*,4.

Antoninus (Imperator 198–217), I,*b*,2; VIII,*b*,2.

Antonius de Albertis (Antonio di Niccolo degli Alberti), I,*b*,4 (tr). 1495–*ca.* 1555. Florentine of scholarly interests. Ferrari p. 13.

Apollo, V,*b*,1.

Argyropylus, J. (Giovanni Argiropulo), V,*b*,1. 1410–*ca.* 1491. Humanist and translator. G. Cammelli, *Giovanni Argiropulo* (Firenze, 1941).

Aristoteles, I,*b*,2; III,*a*,2; III,*b*,2; IV,*b*,2; V,*b*,1; VI,*b*,3; VI,*b*,5; VII,*a*,1; VII,*b*,3; VII,*b*,6; VIII,*b*,2; VIII,*b*,4; IX,*b*,2; XII,*b*,3; XV,*b*,2; XV,*b*,4; XVII,*a*,1; XVII,*b*,2.

Asulanus, A. (Andrea Torresano d'Asola), I,*a*,1. 1451–1529. Printer associated with Aldo Manuzio. *Enc. ital.* XXXIV, 68.

Asulanus, F. (Francesco Torresano d'Asola), III,*a*,1 (ed); IV,*a*,1 (ed); VI,*a*,1 (ed). d. 1546. Son of A. Torresano and printer. D. Bernoni, *Notizie biografiche dei ragguardevoli Asolani* (Oneglia, 1863).

Athenaeus, VII,*a*,1.

Averroes, I,*b*,2; VII,*b*,3.

Averroista, VII,*b*,3.

Avicenna, I,*b*,2.

Bagolinus, H. (Girolamo Bagolino), VIII,*b*,2 (tr); IX,*b*,2 (tr); XII,*b*,1 (tr); XII,*b*,3 (tr). d. *ca.* 1540. Philosopher and physician of Padua. G. M. Mazzuchelli, *Gli scrittori d'Italia*, 2 vols. (Brescia, 1753–1763) I, 300.

Bagolinus, J. B. (Giambattista Bagolino), XII,*b*,3 (tr). d. 1552. Son of H. Bagolinus, professor of philosophy and medicine at Padua. Mazzuchelli, *op. cit.* II, 65.

Barbarus, Hermolaus (Ermolao Barbaro), I,*b*,2; V,*b*,1. 1453–1493. Humanist. *Enc. ital.* VI, 132.

Boethius Severinus, IX,*b*,2.

Bonamicus, Lazzarus (Lazzaro Bonamico), VI,*a*,1. 1497–1552. Humanist and teacher. *Enc. ital.* VII, 381–382.

Brutus, V,*b*,1; VI,*b*,3(?).

Camotius, J. B. (Giambattista Camozzi), VI,*b*,5 (tr). 1515–1581. Philosopher and linguist. Tiraboschi, VII, 1507–1508.

Camotius, J. F. (Gianfrancesco Camozzi), VI,*b*,5. Flourished second half of sixteenth century. Printer active during period 1555–71. F. Ascarelli, *La tipografia cinquecentina italiana* (Firenze, 1953) 206.

Campegius, A. (Alessandro Campegio), IV,*a*,1 (ded). 1504–1554, Bishop of Bologna and Cardinal, 1551. *Enc. ital.* VIII, 597–598.

Caninius, A. (Angelo Canini), I,*b*,3 (tr). 1521–1557. Scholar and linguist. Tiraboschi VII, 1437–1439.

Canossius, Hieronymus (Girolamo di Canossa), XV,*a*,1 (ded). 1502–1526. Scholar and churchman. G. della Corte, *Dell' istoria di Verona*, 2 vols. (Verona, 1596) Part II, 574 f.

Carolos (Imperator 1519–1556), VII,*b*,7.

Cervinus, M. (Marcello Cervini), XII,*b*,4 (ded). d. 1555 as Pope Marcellus II.

Chrysippus, VIII,*b*,2.

Cicero, IV,*b*,2; V,*b*,1; VI,*b*,3; VII,*b*,6; VIII,*b*,2.

Clemens VII (Papa 1523–1534), V,*b*,1 (ded).

Clesius, Bernardus (Bernardo Clesio), VI,*b*,3 (ded). 1489–1539. Bishop of Trent, Cardinal 1530. *Enc. ital.* X, 584–585.

Collenucius, P. (Pandolfo Collenuccio), XVII,*b*,4. 1444–1504. Statesman and humanist. *Enc. ital.* X, 744.

Contarenus, G. (Gaspare Contarini), I,*a*,1 (ded). 1483–1542. Cardinal in 1535. *Enc. ital.* XI, 228.

Cornellia, Caterina (Caterina Corner *or* Cornaro), XVI,*b*,1. d. 1510. Married 1472 to James II of Cyprus. *Enc. ital.* IX, 447.

Cornellius, Ant. (Antonio Corner *or* Cornaro), XVI,*b*,1. Fl. *ca.* 1500. Professor and diplomat. J. L. Heiberg, *Beiträge zur Geschichte Georg Valla's* (*Beihefte zum Centralblatt für Bibliothekwesen* XVI) Leipzig 1896 p. 102, note 6.

Cornellius, G. (Giorgio Corner *or* Cornaro) XVI,*b*,1. d. 1527. Venetian statesman. E. A. Cicogna, *Delle inscrizioni veneziane* 6 vols. (Venezia, 1824–53) VI, 815–816.

Crinitus, P. (P. Crinito), XVII,*b*,4. 1465–1504. Humanist. U. Chevalier, *Répertoire des sources historiques du moyen age.* Part I. Bio-Bibliographie 2 vols. Paris, 1905–1907, I, 1072.

Dactylus, Lazzarus (Lazzaro Dattilo *or* Dattaro), XVII,*b*,3. Fl. at end of fifteenth and beginning of sixteenth century. Physician and natural philosopher. P. Argelatus, *Bibliotheca scriptorum Mediolanensium* (Milano, 1745) I, 709 and J. L. Heiberg, *op. cit.* (under Cornellius, Ant., above) p. 100, note 1.

Danesius, P. (Pierre Danès), XII,*a*,1 (ded). 1497–1577. French classicist. J. E. Sandys, *A History of Classical Scholarship*, 3 vols. (Cambridge 1903–1908) II, 181.

Davionus, J. (Jean Davion), XVII,*b*,5 (tr). Fl. in the middle of the sixteenth century in France. Classical scholar. Known to me only from this preface and from the preface to his edition of Nicolaus Leonicenus' translation of the *Aphorismi* of Hippocrates.

Demosthenes, VII,*b*,6.

Dido, VIII,*b*,2.

Dionysius Atheniensis, XVII,*b*,2.

Donatus, Aloisius (Alvise Donato), XV,*b*,5. Fl. middle of sixteenth century. Venetian merchant. Mentioned in diary of M. Sanuto, e.g., 1532–1533 Vol. LVII (Venezia, 1902) p. 358; 623.

Donatus, Hieronymus (Girolamo Donato) I,*b*,2 (tr); V,*b*,1. *ca.* 1454–1511. Venetian statesman and man of letters. Tiraboschi, VI, 1095–1096.

Donatus, Matthaeus (Matteo Donato), XV,*b*,5 (ded). Fl. after middle of sixteenth century. Son of Aloisius Donatus listed above. Known to me only from this preface.

Dorotheus, Guilelmus (Guglielmo Doroteo) VII,*b*,3 (tr); XV,*b*,2 (tr) XV,*b*,3. *ca.* 1500–*ca.* 1571. Scholar of Augustinian Order. D. A. Perini, *Bibliographia Augustiniana . . . Scriptores Itali* (Firenze, 1929–37) II, 38–39.

Epicurus, IV,*b*,2.

Erasmus, XV,*b*,3. Desiderius Erasmus, *ca.* 1466–1536.

Eudemus, I,*b*,2.

Eustratius, VI,*b*,4.

Felicianus, J. B. (Giovanni Bernardo Feliciano, also called Regazzola) III,*b*,2 (tr). *ca.* 1490–1552. Philosopher, physician, and humanist. Tiraboschi, VII, 2063.

Ferdinandus (Rex Aragoniae), VII,*b*,7. d. 1516.

Ferdinandus Rex Romanorum (=Imperator 1556–1564) VI,*b*,3.

Ferro, Hieronymus a (Girolamo Ferro), XV,*b*,2. d. 1561. Venetian statesman and man of letters. See A. Zeno in G. Fontanini, *Biblioteca dell'eloquenza italiana* 2 vols. (Venice, 1753) I, 150 and II, 349.

Ficinus, M. (Marsilio Ficino), V,*b*,1 1433–1499. Florentine Platonist. *Enc. ital.* XV, 221–222.

Francinus, Ant. (Antonio Francini), III,*a*,2 (ed). Fl. first part of sixteenth century. Scholar and editor. A. M. Bandini, *De Florentina Iuntarum Typographia* (Lucae, 1791) Pars. I, 86–91.

Franciscus I (Rex Francorum 1515–1547), VII,*b*,3; VIII,*b*,4. (ded).

Fremiotus, L. M. (L. M. Frémyot), VII,*b*,5 (ded). Fl. middle of sixteenth century. French poet, of Dijon. C. Dejob, *Marc-Antoine Muret* (Paris, 1881) p. 58, note 1.

Galen, I,*b*,2; VII,*a*,1; VII,*b*,7; XVII,*b*,3.

Gaza, Theodorus, I,*b*,2; V,*b*,1; VI,*b*,3; XVII,*b*,2 (tr); XVII,*b*,4; XVII,*b*,5. 1400–1476. Greek humanist. *Enc. Ital.* XVI, 468.

Gherardius, A. (Alvise Gherardi), VII,*b*,6. Fl. at Florence during middle of sixteenth century and enjoyed support of Cosimo I. Relative of P. Gherardi. Known to me only from this preface.

Gherardius, P. (Pietro Gherardi), VII,*b*,6 (tr). Fl. in second half of sixteenth century. Florentine man of letters and poet. U. Viviani, *Medici, Fisici, e Cerusci della Provincia Aretina* (Arezzo, 1923) p. 132–133.

Gibertus, M. (Giovanni Matteo Giberti), V,*b*,1. 1495–1543. Diplomat, scholar, and churchman. *Enc. ital.* XVII, 96.

Guzmanus, Sylva (Diego Guzmán de Silva), VII,*b*,7. Fl. second half of sixteenth century. Spanish diplomat, R. B. Merriman, *Rise of the Spanish Empire*, 4 vols., (New York, 1918–1934) IV, 274 f. and 291. E. A. Cicogna, *Saggio di bibliografia Veneziana* (Venezia, 1847) p. 466.

Gyrlandus, Hercules (Ercole Girlando), XV,*a*,1 (ed). Fl. *ca.* 1525. Editor and secretary. M. E. Cosenza, *Biographical and Bibliographical Dictionary of the Italian Humanists*, microfilm, (New York, 1955) *s.v.* Girlandus.

Hervetus, G. (Gentien Hervet), XII,*b*,4 (tr). 1499–1584. French writer and translator. C. Branine, J. Debar-

bouiller, and C.-F. Lapierre, *Les hommes illustres de l'Orléanais*, 2 vols. (Orleans, 1852) I, 364–368.

Hieronymus, XVII,*b*,4.

Hippocrates, I,*b*,2.

Homerus, V,*b*,1; XV,*b*,3.

Horatius, XV,*b*,3.

Iason, V,*b*,1.

Job, VII,*a*,1.

Judecus, Nicolaus (Niccolo Giudeco), V,*b*,1. Fl. first part of sixteenth century. Venetian, member of the Aldine Academy. A. Firmin-Didot, *Alde Manuce* (Paris, 1875) 149; 455.

Leo X (Papa 1513–1521), III,*a*,2.

Lotharingia, Johannes de (Jean de Lorrain), XVII,*b*,5 (ded). D. 1550. Bishop of Metz, Cardinal in 1518. Eubel, C. etc., *Hierarchia catholica medii aevi* (1898 f.) Vol. III, 19.

Lucretius, IX,*b*,2.

Madius, V. (Vincenzo Maggi), VI,*b*,4; XII,*b*,3 (ded). d. *ca.* 1564. Philosopher. *Enc. ital.* XXI, 886.

Manutius, Aldus (Aldo Manuzio), I,*a*,1; VII,*a*,1 (ed); VIII,*b*,2; XVII,*a*,1 (ed). 1449–1515. Printer and humanist. *Enc. ital.* XXII, 182–184.

Marcellus, G. (Gaspardo Marcello), XV,*b*,4 (tr). Fl. first half of sixteenth century. Philosopher and physician at Padua. G. Vedova, *Biografia degli Scrittori Padovani*, 2 vols. (Padova, 1832–1836) I, 588.

Marlianus, Johannes (Giovanni Marliani), XVII,*b*,3 (ded). D. 1483. Scientist and philosopher. M. Clagett, *Giovanni Marliani and Late Medieval Physics* (New York, 1941).

——, Hieronymus, Petrus Antonius, Paulus, XVII,*b*,3. Sons of Giovanni Marliani, see Clagett, *op. cit.*, p. 12–13.

Martellus, Ugolinus (Ugolino Martello), VI,*b*,4. d. 1592. Poet and scholar. Ferrari p. 446.

Maurocoenus, Marcus (Marco Morosini), XV,*b*,2 (ded). d. 1569. Venetian senator and poet. Ferrari, p. 481.

Maynardus, J. (Giovanni Manardi), XVII,*b*,4. 1462–1536. Philosopher and physician of Ferrara. U. Chevalier, *op. cit* (under Crinitus, P., above) I, 2980.

Medici (familia), V,*b*,1.

Medici, Franciscus, VII,*b*,6 (ded). 1541–1587. Grand-duke of Tuscany. *Enc. ital.* XV, 862.

Melioratus, Remigius (Remigio Migliorati), VII,*b*,6. 1510–1554. Doctor and philosopher at Padua and Pisa. U. Viviani, *op. cit.* (under P. Gherardius, above) p. 142–144.

Meliorius, A. (A. del Migliore), VII,*b*,6. Fl. second half of sixteenth century. Consul of Florentine Academy in 1563. Salvino Salvini, *Fasti consolari dell' Accademia Fiorentina* (Firenze, 1717) p. 165–168.

Mendozza, D. H. (Diego Hurtado de Mendozza), III,*b*,2 (ded). 1503–1575. Spanish diplomat and writer. *Enc. ital.* XVIII, 609.

Michael Ephesius, IV,*a*,1.

Mucenigus, Ludovicus (Alvise *or* Luigi Mucenigo) XVII,*b*,3 (ded). Fl. second half of fifteenth century. Venetian, interested in letters. E. A. Cicogna, *op. cit.* (under Cornellius, G., above) II, 154 f. and spec. 157; P. Litta, *Famiglie Celebri Italiane* (Milano, 1819–74) Vol. X. Mocenigo di Venezia, Tavola III.

Muretus, M. A. (Marc-Antoine Muret), VII,*b*,5 (tr). 1526–1585. French classical scholar, after 1554 in Italy. C. Dejob, *Marc-Antoine Muret* (Paris, 1881).

Musurus, M. (Marco Musuro), VII,*a*,1. 1470–1517. Greek humanist. *Enc. ital.* XXIV, 164.

Nabascuensis, Johannes (Juan de Nabasques *or* Nevasquez), XV,*b*,3 (tr). Fl. toward middle of sixteenth century. Scholar and physician. N. Antonius, *Bibliotheca Hispana Nova*, 2 vols. (Madrid, 1783–1788) I, 748.

Nicolaus V. (Papa, 1447–1455), V,*b*,1; XVII,*b*,2 (ded).

Niphus, Augustinus (Agostino Nifo), III,*a*,2 (ded). VIII,*b*,2. 1473–1538 or 1545. Philosopher. *Enc. ital.* XXIV, 811.

Nobilius, Flaminius (Flaminio Nobili), VII,*b*,6. Fl. second half of sixteenth century. Professor of logic and law at Pisa. G. Saitta, *Il pensiero italiano nell' umanesimo e nel Rinascimento*, 3 vols. (Bologna, 1949–1951) II, 120–121.

Nogarola, Ludovicus (Luigi Nogarola), VI,*b*,3 (tr). d. 1554. Italian aristocrat, interested in religion and learning. S. Maffei, *Verona illustrata*, 4 vols. (Milano, 1825) III, 311–317.

Oedipus, V,*b*,1.

Olympiodorus, I,*b*,2; VI,*b*,4; VI,*b*,5.

Passerus, Marcus Antonius (Marcantonio Passero), III,*a*,1. 1491–1563. Professor at Padua. Ferrari. p. 522.

Passerus, Nicolaus (Niccolo Passero) III,*a*,1 (ded). d. 1522. Father of Marcantonio P., professor at Padua. Tiraboschi, VII, 2, p. 591. A. Riccoboni, *De gymnasio Patavino* (Patavii, 1598) f. 18v.

Pausanias, VII,*a*,1.

Petrellius, Bernardus (Bernardo Petrelli), VII,*b*,6. Fl. second half of sixteenth century. Professor of logic at Padua. L. Jacobillus, *Bibliotheca Umbriae* (Fulgineae, 1658) p. 72.

Petronigra, Francescus (Francesco Pietranera) IV,*b*,2. d. 1563. Milanese secretary of state, and man of letters. F. Arisi, *Cremona literata* (Parma, 1702–1741) II, 237–239.

Philalthaeus, L. (Lucilio Filalteo, also called Maggi). IV,*b*,2 (tr). *ca.* 1510–1578. Physician and teacher. Tiraboschi, VII, 917–925.

Philippus II (Hispaniarum rex, 1556–1598), VII,*b*,7 (ded).

Philoponus (Johannes Grammaticus), I,*b*,2; VI,*a*,1; VI,*b*,4; VI,*b*,5; XII,*b*,3.

Piccolomineus, A. (Alessandro Piccolomini), VI,*b*,4 (tr) 1508–1578. Scholar and literary man; 1574 Archbishop of Patrasso. *Enc. ital.* XXVII, 156.

Piccolomineus, Franciscus Bandineus (Francesco Bandini Piccolomini) VI,*b*,4 (ded). d. 1588. Archbishop of Siena 1529–1588. Eubel, *op. cit.* (under Lotharingia, J., above) III, 316.

Piccolomineus, Hieronymus Mandoli (Girolamo Mandoli Piccolomini), VI,*b*,4. Fl. toward middle of sixteenth century. Member of Mandoli branch of Piccolomini family. Known to me only from this preface.

Pico, J. F. (Giovanni Francesco Pico), XVII,*b*,4 (ded). 1470–1533. Philosopher. Chevalier, *op. cit.* (under Crinitus, above) II, 3661.

Pisanus, Victor (Vettore Pisano), XVII,*b*,3. Fl. end of fifteenth and beginning of sixteenth century. Editor and writer. E. A. Cicogna, *op. cit.* (under Cornellius, G., above) I, 174–175.

Pius, Albertus (Alberto Pio), VII,*a*,1 (ded). 1475–1550. Prince of Carpi, closely connected with Aldo Manuzio. *Enc. ital.* XXVII, 310.

Plato, I,*b*,2; III,*a*,2; III,*b*,2; IV,*b*,2; V,*b*,1; VII,*a*,1; VII,*b*,6.

Plutarch, XVII,*b*,4.

Politianus, Angelus (Angelo Poliziano), XVII,*b*,4 (tr). XVII,*b*,5. 1454–1494. Florentine humanist. *Enc. ital.* XXVII, 690–693.

Porphyrius, VIII,*b*,2.

Psellus, M., VI,*b*,5.

Rasarius, J. B. (Giambattista Rasario), VII,*b*,7 (tr); XV,*b*,5 (tr). 1517–1578. Linguist and teacher. Tiraboschi, VII, 1492–1493.

Rudolfus, Nicolaus (Niccolo Ridolfi), XV,*b*,4 (ded). 1501–1550. Archbishop of Florence and Cardinal. R. Ridolfi, "La biblioteca del cardinale Niccolo Ridolfi (1501–1550)" *La Bibliofilia* XXXI (1929) 173–193.

Rufus, Christopher (Cristoforo Rossi?), VII,*b*,6. Fl. second half of sixteenth century. Professor of philosophy and letters. L. Jacobillus, *Bibliotheca Umbriae* (Fulgineae, 1658) p. 89.

Saccus, J. P. (Giacomo Filippo Sacco), IV,*b*,2 (ded). Fl. first half of sixteenth century. Milanese statesman and lawyer. *Enc. ital.* XXX, 394.

Sadoletus, J. (Giacomo Sadoleto), VI,*a*,1 (ded). 1477–1547. Bishop of Carpentras, and Cardinal. *Enc. ital.* XXX, 425–426.

Salviatus, Bernardus (Bernardo Salviati), I,*b*,3 (ded). d. 1568. Ecclesiastical statesman, cardinal in 1560. *Enc. ital.* XXX, 586.

Scotus, Octavianus (Ottaviano Scoto), VII,*b*,3; XV,*b*,2(?). d. 1552. Venetian printer. *Enc. ital.* XXXI, 220.

Sepulveda, J. G. (Juan Gines de Sepulveda), V,*b*,1 (tr). 1490–1573. Spanish humanist and historian. *Enc. ital.* XXXI, 404–405.

Severus (Imperator, 193–211), I,*b*,2; VIII,*b*,2.

Sfortia, Fr. (Francesco Sforza), IV,*b*,2. Duke of Milan, 1522–1535. *Enc. ital.* XV, 857.

Simplicius, I,*b*,2; IV,*a*,1; VI,*b*,4; XII,*b*,3.

Socrates, VII,*a*,1.

Specianus, J. B. (Giambattista Speciani), IV,*b*,2. d. 1545. Active in Milanese politics and culture. P. Argelatus, *Bibliotheca scriptorum Mediolanensium* (Milano, 1745) II, 2172–2174.

Speronius, Sp. (Sperone Speroni), VI,*b*,4. 1500–1588. Philosopher and man of letters. *Enc. ital.* XXXII, 342.

Spinellus, J. B. (Giambattista Spinelli, Conte di Cariati), VIII,*b*,2 (ded). Fl. first part of sixteenth century. Active in imperial and Neopolitan politics in Italy. A. Firmin-Didot, Alde Manuce (Paris, 1875) 385; 393. G. dalla Corte, *op. cit.* (under Canossius, above) II, 566 etc.

Strabo VII,*a*,1.

Taurellius, L. (Lelio Torelli), VII,*b*,6. 1489–1576. Classical scholar. F. A. Eckstein, *Nomenclator Philologorum* (Leipzig, 1871) p. 571.

Themistius, I,*a*,1; I,*b*,2; VI,*b*,4; XII,*b*,3.

Theophrastus, I,*b*,2; VI,*b*,3; XVII,*a*,1.

Thucydides, XVII,*b*,2.

Trincavallus, Victor (Vettore Trincavelli), I,*a*,1 (ed); XII,*a*,1 (ed). 1491–1563, Scholar and doctor. G. degli Agostini, *Notizie istorico-critiche intorno la vita e le opere degli scrittori Viniziani* (Venezia, 1752–1754) II, 529; 536–537.

Turrius, H. (Girolamo della Torre), IX,*b*,2. 1444–1506. Professor of medicine in Padua and Ferrara. S. Maffei, *op. cit.* (under L. Nogarola, above) III, 275–276.

Turrius, J. B. (Giovanni Battista della Torre), IX,*b*,2 (ded). Fl. first part of sixteenth century. Philosopher and astronomer, Maffei, *op. cit.* III, 277–279.

Turrius, M. A. (Marcantonio della Torre), IX,*b*,2. d. after 1510, aged 30. Brilliant scholar and teacher at Padua and Pavia. S. Maffei, *op. cit.* III, 276–277.

Tussanus, J. (Jacques Toussain), XVII,*b*,5. *ca.* 1498–1547. French classicist. J. E. Sandys, *A History of Classical Scholarship*, 3 vols. (Cambridge, 1903–1908) II, 181.

Ulysses, VII,*a*,1.

Valla, G. (Giorgio Valla), XVI,*b*,1 (tr) XVII,*b*,3 (tr); XVII,*b*,4; XVII,*b*,5. 1447–1500. Italian humanist. J. L. Heiberg, *op. cit.* (under Cornellius, Ant., above).

Varro, M. V,*b*,1; VI,*b*,3.

Venereus, M. A. (Marcantonio Venier), VII,*b*,3 (ded). d. 1552. Venetian senator, active as diplomat and as writer. M. Foscarini, *Della letteratura Veneziana* (Padova, 1752) I, p. 73, note 203.

Vergilius, VIII,*b*,2; XV,*b*,3.

Vernias, Nicoletus (Nicoletto Vernia), XVII,*b*,3. *ca.* 1420–1499. Philosopher and professor at Padua. *Enc. ital.* XXXV, 174.

Victorius, Fr. (Francesco Vittorio), VII,*a*,1. b. *ca.* 1485—d. after 1528. Philosopher and teacher. Tiraboschi, VII, 907–912.

Victorius, P. (Pietro Vettori), VII,*b*,6. 1499–1585. Greatest Italian Greek scholar of sixteenth century. Sandys, *op. cit.* (under Tussanus, J., above) II, 135–140.

Virgilius, Marcellus (Marcello Virgilio), III,*a*,2. 1464–1521. Florentine secretary of state and scholar. A. M. Bandinio, *op. cit.* (under A. Francinus, above) I, 38–46.

Xenophon, VII,*a*,1.

Zeno, IV,*b*,2.

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